

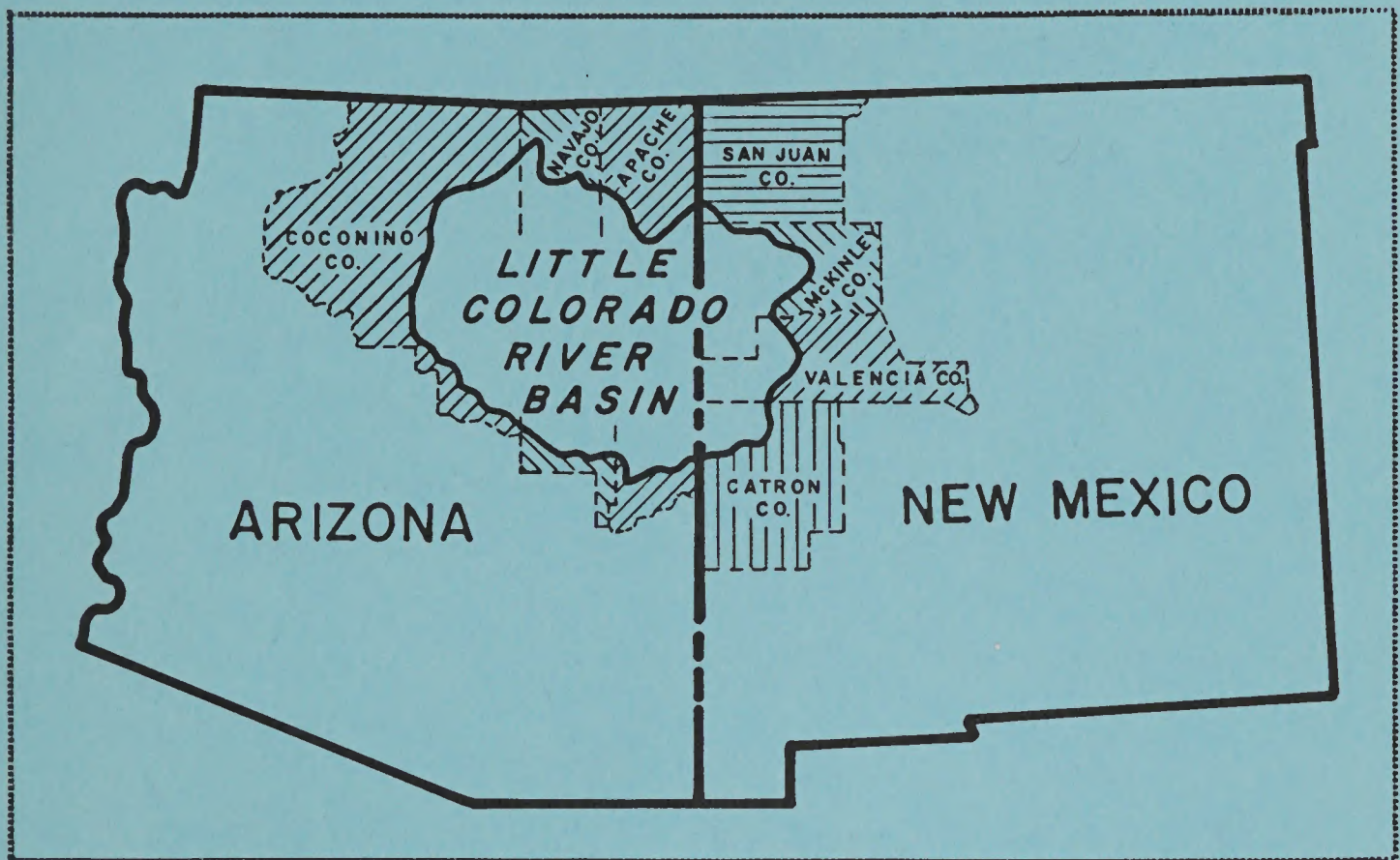
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LITTLE COLORADO RIVER BASIN ARIZONA-NEW MEXICO

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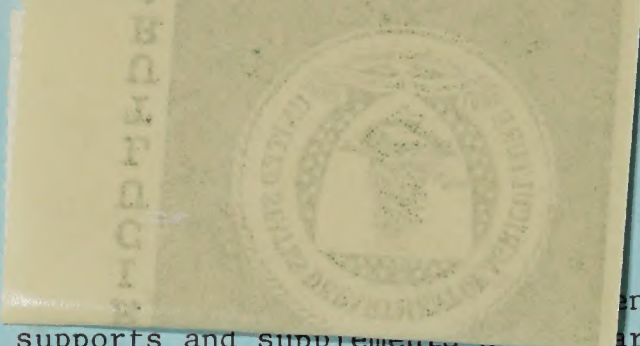
APPENDIX IV RECREATION, FISH & WILDLIFE, AND TIMBER



U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ECONOMIC RESEARCH SERVICE
FOREST SERVICE

In cooperation with the states of
ARIZONA AND NEW MEXICO

December 1981



The "Recreation, Appendix is one of four (4) such appendices which supports and supplements the Primary Report". Titles and sub-sections of each appendice are as follows:

APPENDIX I: DESCRIPTION OF BASIN

Section 1: Physical Description

Section 2: Socio-Economic Base

APPENDIX II: WATER RESOURCES

Section 1: Irrigation

Section 2: Municipal and Industrial Water Supply

Section 3: Rural Domestic and Livestock Water Supply

Section 4: Development of Surface Water Resources

Section 5: Surface Water Budgets (Including Pumped Groundwater)

APPENDIX III: EROSION AND SEDIMENT, AND FLOODING

Section 1: Erosion and Sediment

Section 2: Flooding

APPENDIX IV: RECREATION, FISH AND WILDLIFE, AND TIMBER

Section 1: Recreation

Section 2: Fish and Wildlife

Section 3: Timber

LITTLE COLORADO RIVER BASIN
COOPERATIVE STUDY

ARIZONA-NEW MEXICO

APPENDIX IV

RECREATION, FISH & WILDLIFE, TIMBER

This Appendice was prepared pursuant to Section 6 of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat.666, as amended and supplemented). This report is divided into three sections. Section 1 presents information on existing and projected supply, demand, and unmet recreation demand in the Basin. Potential developments are identified and impacts of developing these potentials are evaluated. Section 2 presents information on responsibilities and existing management of wildlife habitat, populations, and fisheries. Opportunities for improved management and developments are presented. Section 3 presents information on markets for forest products, protection of forested land, reforestation and future management goals. Opportunities for improved management and uses are presented.

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LITTLE COLORADO RIVER BASIN
COOPERATIVE STUDY

ERRATA SHEET

1. Effective July 1, 1981, Valencia County, New Mexico, was divided into two counties. That portion within the Little Colorado River Basin became Cibola County.
2. In June 1981, the Economics and Statistics Service was reorganized to form the Economic Research Service and the Statistical Reporting Service.
3. The Arizona Water Commission is now the Arizona Department of Water Resources.

LITTLE COLORADO RIVER BASIN
COOPERATIVE STUDY

APPENDIX IV
RECREATION, FISH & WILDLIFE, AND TIMBER

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SECTION 1 - RECREATION

SECTION 2 - FISH AND WILDLIFE

SECTION 3 - TIMBER

SECTION I
RECREATION

SECTION 1

RECREATION

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SECTION 1

RECREATION

INTRODUCTION

The climate, scenic attractions, and proximity to major metropolitan areas, makes the Little Colorado River Basin an important recreational resource for weekend and vacation use by residents of Phoenix, Tucson, and Albuquerque. Basin residents participate in both day-use and camping activities. The major recreation attractions within the Basin include the Petrified Forest National Park, El Morro, Walnut Canyon, Sunset Crater, and Wupatki National Monuments, Lyman Lake State Park, and National Forest recreation sites at Quemado Lake, Greer, Lakeside, Woods Canyon, Ashurst Lake, and Willow Springs Lake. Water related activities, including camping near water, create the most demand for activity occasions.

The Basin provides recreation opportunities for all seasons. During the winter months, the Arizona Snow Bowl near Flagstaff provides good alpine skiing. Cross-country skiing and snowmobiling are available in the Big Cienega, Mormon Lake, Greer, and other areas along the Mogollon Rim. Fishing and turkey hunting are popular spring activities. The heaviest recreation use occurs during the summer months when the forested areas provide climatic relief for residents of southern Arizona and tourists from other states. Camping, picnicking, fishing, nature study, and hiking are the most popular activities.

PROBLEMS AND OBJECTIVES

ARIZONA

The Arizona Statewide Comprehensive Outdoor Recreation Plan (SCORP) has identified five major recreation related problems in planning Region III. Region III includes all of the three Arizona counties (Apache, Navajo, and Coconino) involved in this basin study and Yavapai County. The five major problems identified are:

1. Transportation;
2. Access, poor road conditions, lack of roads, and road closures;
3. Lack of awareness of recreational opportunities;
4. Overcrowding of existing facilities;
5. Vandalism.

Three of the above-mentioned problems, numbers 2, 3, and 4, constitute the major elements of this study. The other problems, transportation and vandalism, are not specific concerns of this river basin study.

There are many areas in the Little Colorado River Basin that have a high potential for recreation use, but lack adequate access for highway type vehicles. These areas are located primarily on forest lands and are

suitable for recreation activities such as picnicking, camping without facilities, nature study, hiking, and backpacking. It is an objective of this study to develop alternative plans for the recreational uses of these resources.

During the late spring, summer, and early fall, the city of Phoenix and Maricopa County constitute a virtual oven with daytime temperatures exceeding 100°F. The city of Tucson and Pima County are only slightly cooler. The cooler mountain and plateau temperatures make the Little Colorado River Basin an attractive place for the residents of Phoenix and Tucson to spend their vacations and weekends seeking relief. As shown in Table 1-1, many users of the recreation facilities in the Arizona portion of the Basin come from the State's metropolitan counties. This heavy use, when combined with use from residents of the river basin and tourists from other states, creates overuse of many of the recreation areas and results in degradation of the resources. It is an objective of this study to identify areas that could be developed into quality recreation areas and to develop alternative proposals that would help to alleviate existing and future overuse.

In spite of the fact that overuse of recreation areas is common in the Arizona portion of the Basin, there are areas capable of supporting heavier use. Generally, these areas are underused because of lack of awareness of the recreational opportunities, or a lack of basic facilities. It is an objective of this study to develop alternative proposals that would increase the use of these areas.

NEW MEXICO

The problems confronting recreationists in the New Mexico portion of the Basin are overcrowding of developed recreation sites during many weekends and holidays and lack of knowledge of recreational opportunities.

Recreation sites are generally developed near water, such as streams, lakes, and reservoirs. The lack of water-based recreation sites causes overcrowding at existing developed sites. An objective of this study is to identify areas that have potential for development of public water-based recreation.

The Little Colorado River Basin, New Mexico, offers many opportunities for recreational activities, such as hiking and backpacking, nature study, camping without facilities, four-wheeling and trail-biking, and cross-country skiing. These activities may be referred to as dispersed recreation. Areas that support these types of activities are underused because of a lack of knowledge about the recreational opportunities. An objective of this study is to increase public awareness of the opportunities for dispersed recreation.

TABLE 1-1 - Residence of People Participating in Outdoor Recreation in the Little Colorado River Basin,
by County (Arizona Residents Only)

Activity	Use Occurring In Navajo County				Use Occurring In Apache County				Use Occurring In Coconino County			
	From Maricopa County (Percent)	From Pima County (Percent)	From Planning District 3 (Percent)	From Maricopa County (Percent)	From Pima County (Percent)	From Planning District 3 (Percent)	From Maricopa County (Percent)	From Pima County (Percent)	From Planning District 3 (Percent)	From Maricopa County (Percent)	From Pima County (Percent)	From Planning District 3 (Percent)
Fishing	38	20	33	34	9	44	49	2	44			44
Picnicking	26	10	54	9	9	65	37	0	62			62
River and Lake Swimming	23	19	55	0	34	33	28	2	70			70
Camping - No Facilities	41	13	38	38	17	35	60	2	31			31
Hike - Backpacking	48	13	35	32	16	50	51	2	42			42
Nature Study	35	3	59	8	7	77	37	4	58			58
Camping - With Facilities	50	29	10	50	13	15	61	5	28			28
Four-Wheeling	22	28	50	30	10	60	43	0	54			54
Power Boating - No Skiing	18	5	73	36	10	18	45	3	49			49
Power Boating - With Skiing	33	33	34	0	67	0	54	0	46			46
Trail Bike	50	0	50	33	0	67	25	0	75			75
Canoe, Sail, or Row Boating	17	75	8	24	28	29	73	9	18			18
Snow Ski	14	14	0	63	11	16	55	0	42			42
Sled - Toboggan	37	25	38	0	0	100	42	3	52			52
Cross-Country Skiing	0	0	0	0	0	100	31	0	69			69
Snowmobiling	67	17	0	0	0	100	50	0	50			50

1/ This planning district includes Apache, Navajo, Coconino, and Yavapai Counties, Arizona.

Source: Arizona Statewide Comprehensive Outdoor Recreation Plan, Technical Document, December 1977.

RECREATION INVENTORY AND PROJECTED SUPPLY

ARIZONA

An inventory of 22 specific types of outdoor recreation activities and facilities has been completed for Arizona and is included in the December 1977 Arizona Statewide Comprehensive Outdoor Recreation Plan (SCORP), Technical Document. For the sake of brevity, the complete inventory is not reproduced in this report. Existing supply of recreation facilities for this report is based on the amount of use or activity occasions by residents and non-residents in 1975. The amount of use is based on the participation rates for each activity as shown in the Arizona SCORP.

Table 1-2 shows this existing and projected supply, demand, and unmet demand in activity occasions for Coconino, Navajo, and Apache Counties. An activity occasion represents a one-time participation, i.e., a 2-hour picnic, a one day hike, or a one night camping trip. Each activity is calculated separately. A person on a camping trip could also partake in activity occasions of fishing, boating, hiking, nature study, etc. If the camper engaged in each of these activities, an activity occasion would be counted for each activity.

The projected supply figures represent those conditions that are expected to exist in the future if no new water resource or recreation projects or programs other than authorized and funded projects and programs are implemented. At the time of this writing, there were no projects authorized or funded for installation during the evaluation period.

NEW MEXICO

An inventory of the supply of recreational resources in New Mexico is contained in "Outdoor Recreation 1976, A Comprehensive Plan for New Mexico," New Mexico SCORP. Existing supply of outdoor recreation, expressed in activity occasions, is based on data contained in this report. Recreation supply in the Little Colorado River Basin, New Mexico, is the amount by activity for the three county area, McKinley, Valencia, and Catron Counties. Table 1-2A shows the existing and projected supply, demand, and unmet demand.

ONGOING PROGRAMS

Included in Tables 1-2 and 1-2A for Arizona and New Mexico are the effects of ongoing recreation programs of the Forest Service. The effect of these programs on the supply of opportunities is significant. The following summarizes the current ongoing recreation programs on National Forest lands.

ARIZONA

Picnicking

The demand for picnicking often exceeds available facilities on weekends and holidays. Although the Forest Service has placed greater emphasis on

TABLE 1-2 - Existing and Projected Supply, Demand, and Unmet Recreation Demand, Future Without Plan Conditions In Activity Occasions, Little Colorado River Basin

Arizona Three County Area ^{1/}

Activity	Base Year - 1975			Project - 1990			Projected - 2000			Project - 2020		
	Supply	Demand	Unmet Demand	Supply	Demand	Unmet Demand	Supply	Demand	Unmet Demand	Supply	Demand	Unmet Demand
Fishing	866,100	949,400	83,300	887,400	1,418,000	530,600	887,400	1,730,600	843,200	887,400	2,407,000	1,519,600
Picnicking	719,100	794,600	75,500	744,100	1,186,500	442,400	760,800	1,448,000	687,200	802,400	2,009,000	1,206,600
River and Lake Swimming	394,900	339,900	0	394,900	507,500	112,600	394,900	619,400	224,500	394,900	859,700	464,800
Camping - No Facilities	805,900	693,600	0	978,300	1,035,800	57,500	1,163,200	1,264,000	100,800	1,534,200	1,754,800	220,600
Hike - Backpacking	752,800	647,900	0	804,000	967,500	163,500	838,600	1,180,700	342,100	906,400	1,638,100	731,700
Nature Study	815,600	701,900	0	990,000	1,048,100	58,100	1,163,200	1,279,000	115,800	1,534,200	1,773,700	239,500
Camping - With Facilities	651,000	716,400	65,400	726,000	1,069,700	343,700	776,000	1,305,300	529,300	901,000	1,807,000	906,000
Four-Wheeling	203,400	205,800	2,400	255,400	307,400	52,000	289,300	375,200	85,900	362,500	521,500	159,000
Power Boating - No Skiing	178,700	187,100	8,400	178,700	279,500	100,800	178,700	341,100	162,400	178,700	474,100	295,400
Power Boating - With Skiing	52,800	55,800	3,000	52,800	83,300	30,500	52,800	101,700	48,900	52,800	141,300	88,500
Trail Bike	84,500	86,100	1,600	106,500	128,600	22,100	120,800	157,000	36,200	151,500	218,400	66,900
Canoe, Sail, or Row Boating	98,800	105,700	6,900	106,000	157,900	51,900	106,000	192,700	86,700	106,000	267,900	161,900
Snow Ski	199,400	171,600	0	199,400	256,400	57,000	199,400	312,900	113,500	419,400	435,500	16,100
Sled - Toboggan	88,400	76,100	0	108,600	113,700	5,100	128,600	138,700	10,100	172,200	193,100	20,900
Cross-Country Skiing	71,200	61,300	0	89,200	91,600	2,400	98,200	111,800	13,600	113,700	155,600	41,900
Snowmobiling	74,200	133,300	59,100	174,000	199,000	25,000	209,200	242,900	33,700	284,400	337,000	52,600

^{1/} Apache, Navajo, and Coconino Counties.

TABLE 1-2A - Existing and Projected Supply, Demand, and Unmet Recreation Demand, Future Without Plan Conditions
In Activity Occasions, Little Colorado River Basin

New Mexico Three County Area 1/

Activity	Base Year - 1975			Projected - 1990			Projected - 2000			Projected - 2020		
	Supply	Demand	Unmet Demand	Supply	Demand	Unmet Demand	Supply	Demand	Unmet Demand	Supply	Demand	Unmet Demand
Fishing	278,500	237,770	0	279,800	386,950	107,150	281,100	475,350	194,250	281,100	782,020	500,920
Picnicking	374,000	227,580	0	494,000	384,650	0	554,000	475,600	0	674,000	781,250	107,250
River and Lake Swimming	63,500	60,270	0	63,500	87,970	24,470	63,500	107,760	44,260	63,500	176,720	113,220
Camping - Primitive	124,420	74,110	0	125,020	125,650	630	155,430	155,430	0	203,120	255,560	52,440
Hike - Backpacking	930,560	166,580	0	930,560	275,190	0	930,560	339,560	0	930,560	558,620	0
Nature Study	960,000	307,350	0	960,000	507,450	0	960,000	629,070	0	1,020,300	1,040,390	20,090
Camping - With Facilities	62,480	38,360	0	106,480	62,450	0	128,480	77,240	0	161,480	126,970	0
Four-Wheeling and Trail Bike	360,000	74,540	0	360,000	120,870	0	360,000	148,980	0	360,000	242,500	0
Boating, Canoeing, Sailing	54,810	57,820	3,010	54,810	90,570	35,760	54,810	110,600	55,790	54,810	199,780	144,970
Power Boating - With Skiing	16,330	34,730	18,400	16,330	48,480	32,150	16,330	59,300	42,970	16,330	98,170	81,840
Snow Ski	0	54,580	54,580	0	91,580	91,580	0	113,020	113,020	0	187,740	187,740
Sled, Toboggan, Innertube	37,640	31,550	0	46,740	49,830	3,090	55,140	60,920	5,780	85,140	101,020	15,880
Cross-Country Ski	8,500	7,200	0	10,100	11,120	1,020	11,600	13,650	2,050	17,000	22,710	5,710
Snowmobiling	3,740	3,240	0	4,440	4,730	290	5,240	5,860	620	7,840	9,540	1,700

1/ McKinley, Valencia, and Catron Counties

campground construction, additional picnic grounds will be constructed. The demand for picnic facilities is sometimes fulfilled by use of campgrounds for picnics.

Camping Without Facilities

Providing dispersed recreation use, including camping, is currently a very high priority for the Forest Service. There are good opportunities within the Basin to develop access for camping in areas with limited or without facilities. The Coconino National Forest is currently conducting an inventory to identify types and amounts of opportunities for dispersed recreation activities.

The biggest demand for camping continues to be for areas adjacent to water. In the future, recreation developments near water will be managed for day use. The visitors' information service must be expanded to direct overnight use to appropriate camping sites. To improve access to scenic and unique forested areas, the Forest Service plans to increase the miles of surfaced roads and provide turnouts on logging roads and other existing roads for parking and for recreation vehicles.

Hiking and Backpacking

Due to the relatively gentle topography most National Forest lands have road access which has limited the need for trails. The exceptions would be in the San Francisco Peaks and the Mount Baldy Wilderness. To date, there has been only moderate demand for recreation trails. To meet the projected demand for hiking, it is possible to use secondary roads, existing trails, or construct new trails.

There is a need to develop trails for various skill levels. These include trails for the handicapped, short loop trails, day use trails, and trails with a high degree of difficulty. There is good opportunity and demand in the Flagstaff area for all types of trails. Some of these could be developed through cooperation with the city and county governments.

The General Crook Historic Trail, from Prescott to Fort Apache, provides an opportunity to meet some of the hiking demands in the Basin. It enters the Basin at Baker Butte and follows the Mogollon Rim Road east to Pinetop, with spurs to vista points along the rim. Portions of the rim trail are currently being restored and posted with trail markers.

Nature Study

The opportunities for nature study are numerous on National Forest lands. Nature study can be accomplished in a variety of ways, depending upon the desires of the forest visitor. Many people hike, camp, picnic, and cross-country ski with the primary purpose being nature study. Therefore, a given facility usually serves to meet the demand for more than one activity.

In 1975, the Forest Service had 10 interpretive sites within the Basin which provided nature study for an estimated 234,000 visitors. The optimum capacity of these sites is 360,000 visitors annually. Additional interpretive sites will be added as demand increases.

Camping with Facilities

By 1990, the Forest Service plans to construct approximately 300 new family units within the Basin; 140 on the Coconino National Forest and 160 on the Apache-Sitgreaves National Forests. By 2020, there should be approximately 1,000 new family units constructed on National Forest lands. These will serve to meet both camping and picnicking demands.

The Forest Service will encourage the development of campground facilities on private lands within and adjacent to National Forest lands. There are opportunities for private campgrounds in forest environments in the Flagstaff, Heber, Show Low, Pinetop, Lakeside, Greer, and Springerville areas.

Four-Wheeling and Trail Bikes

Presently there is no unmet demand on the National Forest. Old logging roads and primitive forest roads provide travelways for these vehicles. As a result of indiscriminate travel by four-wheel drive vehicles and trail bikes on National Forest lands, it was necessary to restrict travel in certain areas as a means to protect vegetation and reduce soil erosion.

Organizational use by these vehicles is permitted in the Pinedale, Blue Ridge, and Eldon Ranger Districts. The National Forests can continue to supply a significant amount of opportunities to engage in these recreational activities on specifically designated areas.

Snow Skiing - Alpine

The Snow Bowl at Flagstaff is the only developed site for downhill skiing in the Basin. It currently can comfortably handle 582 persons at one time. It has the potential to be expanded to a comfortable carrying capacity of 2,800 people.

The maximum opportunity for increased ski development on National Forest land within the Basin would be about 3,000 persons at one time or about 300,000 activity occasions per season. This increased development is expected prior to the year 2020.

Sled - Toboggan - Snow Play

The Coconino National Forest has three potential snow play areas currently in the planning stages within Coconino County. These could be both developed and operated by the County. They are Cinch Hook borrow pit, Kelly Canyon, and Wing Mountain, with a total area of 50 acres. These should be developed by 1990 and accommodate about 50,000 people per season. In addition, there are two potential snow play areas on National Forest land in Flagstaff which could be developed by the City.

The Apache-Sitgreaves National Forests has the facilities to meet most of the demand on the east side of the Basin. Big Cienega Mountain is a popular area for sledding and tubing. It is frequently used by children while their parents ski at nearby Sunrise Ski Area.

The National Forests can accommodate a significant amount of the demand for snow play. The capacity of snow play is limited by the parking capacity for cars.

Cross-Country (Nordic) Skiing

The Coconino National Forest presently has 85 miles of designated cross-country skiing trails in the Mormon Lake area. There are opportunities for developing an additional 200 miles of designated trails by 1990 and another 200 miles by 2020.

Greer has an established touring course with the potential to designate 50 additional miles of trail.

Big Cienega has opportunities to accommodate about 200 people at one time or 2,000 per season.

The area between Heber and Pinetop generally does not have sufficient snow for good cross-country skiing.

Snowmobiling

The Coconino and Apache-Sitgreaves National Forests have facilities to meet all anticipated demand on their resources through 2020. Management problems occur in certain areas from conflicts between cross-country skiers and snowmobilers using the same trails and open areas.

During periods with good snow conditions for snowmobiling and cross-country skiing, available parking is usually limited. Therefore, to provide increased opportunities, provisions must be made during snow removal to allow for additional parking.

NEW MEXICO

Picnicking

There are opportunities to develop picnic sites on the western portion of the Zuni Mountains and near Quemado Lake. Picnic facilities (tables) will be provided in addition to campground developments.

Camping Without Facilities

There are excellent opportunities to provide dispersed camping on both the Gila and Cibola National Forests lands within the Basin. Most of the projected demand can be met on National Forest land.

Hiking and Backpacking

Most of the National Forest lands within the Basin are accessible by roads and have few developed trails. McKenzie Ridge in the Zuni Mountains and the mountains south of Quemado have some scenic and rugged landscape which could provide good opportunities for hiking on primitive roads and existing trails. By year 2020 it is expected that the Continental Divide Trail will be completed. This will provide about 20 miles of new trail along the eastern edge of the Basin.

Nature Study

The opportunities for nature study are numerous on the National Forest lands. Nature study can be accomplished in a variety of ways, depending upon the desires of the Forest visitor. Most nature study is done without facilities.

In 1975, the Forest Service had one interpretive site within the Basin which provided nature study for an estimated 1,000 visitors. The optimum capacity of this site is 12,200 visitors or about 4 percent of the total demand for 1975. Three miles of additional interpretive nature study trail will be developed by year 2000.

Camping With Facilities

By 1990, there will be approximately 200 new campground units constructed on National Forests within the Basin. By year 2000, a total of 300 units and by 2020 a total of 450 units. The majority of these will be on the Zuni Mountains.

Sledding, Tobogganing, Innertubing

There presently is a snow play area at McGaffey Lake. There are opportunities to develop additional areas near McGaffey and Quemado Lakes to meet about 75 percent of the projected demand. Since these areas are remote from heavily populated centers, the priorities for development are low and will be done only as demand increases.

Cross-Country (Nordic) Skiing

The availability of open areas and roads for cross-country skiing currently exceed the demand in the Zuni Mountains and Quemado Lake areas. It is expected the demand will remain low since better snow conditions and facilities exist closer to population centers outside the Basin. Six miles of trail will be constructed in the Zuni Mountains by year 2020.

Snowmobiling

There is some opportunity in the McGaffey area. The only anticipated demand is from the local areas of Gallup and Grants.

RECREATION DEMAND

It was necessary to make several assumptions in the development of the demand projections. The validity of the projections is directly related to the accuracy of the assumptions. Specifically these assumptions are:

1. An adequate supply of some type of motor fuel will be available throughout the projection period.
2. The future participation rates of outdoor recreation, by activity, will remain essentially in the same proportion as exists today.
3. Future resident populations will demand the same opportunities for outdoor recreation as exist today.
4. Historical trends of tourists entering the state will continue throughout the projection periods.

ARIZONA

The recreation demand figures for the Arizona three county area shown on Table 1-2, in activity occasions, are based on data contained in the Arizona SCORP and Arizona highway statistics. The demand projections are based on population projections supplied by the Arizona Department of Water Resources and reflect the number of residents and non-residents who are expected to participate in outdoor recreation activities within the three county area.

NEW MEXICO

Recreation demand for New Mexico is based on population projections contained in New Mexico Water Resources Assessment for Planning Purposes, 1976, and the recreation standards in the New Mexico SCORP. Recreation demand projections, in activity occasions, are shown in Table 1-2A for the Little Colorado River Basin, New Mexico.

These projections focus on three sectors of recreation demand:

1. Resident population of McKinley, Valencia, and Catron Counties;
2. Recreation demand from the Albuquerque SMSA^{1/}. Ten percent of the total SMSA population was used to estimate this demand;
3. Non-resident demand. The percent of total state non-resident recreation that occurs in the Basin was used to estimate the demand from this sector.

RECREATION FACILITIES NEEDED

ARIZONA

For base year 1975 conditions, the Arizona three county area did not suffer from an acute shortage of recreation opportunities. Some minor shortages, however, did occur. One of the most significant shortages was

^{1/} SMSA - Standard Metropolitan Statistical Area.

for campsites with facilities and this shortage only amounted to 262 campsites. Other shortages were for fishing and boating waters, areas for trail bikes and four-wheel drive vehicles, and snowmobiling. For all other activities considered in this study, supply either equaled or exceeded demand.

The projected future conditions indicate that the demand for outdoor recreation will greatly exceed supply by the year 1990. Projections beyond the year 1990 amplify the fact that additional recreation development is needed if the Arizona portion of the Basin is going to satisfy the projected demands. Table 1-3 shows the base year and projected unmet demands for recreation in the Arizona three county area.

NEW MEXICO

Table 1-3A shows the present and projected unmet recreation demand and the facilities that are needed to fulfill that demand by time period. Analysis indicates facilities are presently needed to offset unmet demand for flat-water recreation activities and snow skiing.

Recreation activities centered around lakes and reservoirs are now in short supply. This trend will continue in the future. About 4,800 acres of flat-water will be needed by 2020 in the Little Colorado River Basin, New Mexico.

There is a need for developed snow skiing areas in the Little Colorado River Basin, New Mexico. No developed areas now exist. There are no known plans for development of ski areas in the New Mexico portion of the Basin.

By 2020, facilities will be needed to satisfy unmet demand for most recreation activities. See Table 1-3A.

ALTERNATIVE PLANS

The potential recreation developments considered in this study were formulated using USDA Procedures for Planning Water and Related Land Resources. These procedures identify two broad national objectives, National Economic Development (NED) and Environmental Quality (EQ). Alternative plans, directed toward satisfying each of these national objectives, were formulated. In general terms, the NED alternatives are directed toward increasing the output of goods and services. The EQ alternatives are directed toward enhancing environmental quality by the management, conservation, preservation, creation, restoration, or improvement of certain natural and cultural resources and ecological systems. A recommended alternative for each of the potential developments was formulated after due consideration had been given to both the NED and EQ alternatives.

OPPORTUNITIES FOR USDA PROGRAMS

In order to effectively utilize data from the State Comprehensive Outdoor Recreation Plans, supply, demand, and unmet demand data was developed by

TABLE 1-3 - Recreation Facilities Needed, Future Without Plan Conditions, Little Colorado River Basin

Arizona Three County Area ^{1/}

Activity	Unit and Average Annual Use Per Unit	1975			1990			2000			2020		
		Unmet Demand (Activity Occasions)	Facilities Needed	Unmet Demand (Activity Occasions)	Facilities Needed	Unmet Demand (Activity Occasions)	Facilities Needed	Unmet Demand (Activity Occasions)	Facilities Needed	Unmet Demand (Activity Occasions)	Facilities Needed	Unmet Demand (Activity Occasions)	Facilities Needed
Fishing	Number Surface Acres of Water-115.4 Avg. Ann. Fishing Use	83,300	722	530,600	4,598	843,200	7,309	1,519,600	13,168				
Picnicking	Number Picnic Tables-500 Avg. Ann. Visitor Use	75,500	151	442,400	885	687,000	1,374	1,206,600	2,413				
River and Lake Swimming	Square Feet Beach Area-.75 Avg. Ann. Swimmer Days Use	0	0	112,600	150,114	224,500	299,334	464,800	619,734				
Camping - No Facilities	Number of Sites-220 Avg. Ann. Use	0	0	57,500	261	100,800	458	220,600	1,003				
Hike - Backpacking	Miles of Trail-1,280 Avg. Ann. Use	0	0	163,500	128	342,100	267	731,700	572				
Nature Study	Miles of Trail-2,000 Avg. Ann. Use	0	0	58,100	29	115,800	58	239,500	120				
Camping - With Facilities	Number Campsites - 250 Avg. Ann. Visitor Use	65,400	262	343,700	1,375	529,300	2,117	906,000	3,624				
Four-Wheeling	Miles of Trail-1,000 Avg. Ann. Use	2,400	2	52,000	52	85,900	86	159,000	159				
Power Boating - No Skiing	Number Surface Acres of Water-31 Avg. Ann. User Days	8,400	271	100,800	3,252	162,400	5,239	295,400	9,530				
Power Boating - With Skiing	Number Surface Acres of Water-31 Avg. Ann. User Days	3,000	97	30,500	984	48,900	1,578	88,500	2,855				
Trail Bike	Miles of Trail-1,000 Avg. Ann. Use	1,600	2	22,100	22	36,200	36	66,900	67				
Canoe, Sail, or Row Boating	Number Surface Acres of Water-39 Avg. Ann. User Days	6,900	177	51,900	1,331	86,700	2,223	161,900	4,151				
Snow Ski	Acres-300 Avg. Ann. Use	0	0	57,000	190	113,500	378	16,100	54				
Sled - Toboggan	Acres-1,000 Avg. Ann. Use	0	0	5,100	5	10,100	10	20,900	21				
Cross-Country Skiing	Miles of Trail-90 Avg. Ann. Use	0	0	2,400	27	13,600	151	41,900	466				
Snowmobiling	Miles of Trail-250 Avg. Ann. Use	59,100	236	25,000	100	33,700	135	52,600	210				

^{1/} Includes Apache, Navajo, and Coconino Counties.

TABLE 1-3A - Recreation Facilities Needed, Future Without Plan Conditions, Little Colorado River Basin

New Mexico Three County Area 1/

Activity	Unit and Average Annual Use Per Unit	1975			1990			2000		
		Unmet Demand	Facilities Needed	Unmet Demand	Facilities Needed	Unmet Demand	Facilities Needed	Unmet Demand	Facilities Needed	2020
Fishing	Surface Acres of Water-130 Avg. Ann. Use	0	0	170,150	820	194,250	1,490	500,920	3,850	
Picnicking	Picnic Tables-600 Avg. Ann. Use	0	0	0	20	0	170	107,250	180	
River and Lake Swimming	Square Feet of Beach Area-0.9 Avg. Ann. Use	0	0	24,470	27,200	44,260	49,200	113,220	125,800	
Camping - Primitive	No. of Sites-220 Avg. Ann. Use	0	0	630	3	0	0	52,440	240	
Hike - Backpacking	Miles of Trail-1,280 Avg. Ann. Use	0	0	0	0	0	0	0	0	
Nature Study	Miles of Trail-2,000 Avg. Ann. Use	0	0	0	0	0	0	20,090	10	
Camping - With Facilities	No. of Sites-220 Avg. Ann. Use	0	0	0	0	0	0	0	0	
Four-Wheeling & Trail Bike	Miles of Trail-1,000 Avg. Ann. Use	0	0	0	0	0	0	0	0	
Boating, Canoeing, Sailing	Surface Acres of Water-30 Avg. Ann. Use	3,010	100	35,760	1,190	55,790	1,860	144,970	4,830	
Water Skiing	Surface Acres of Water-25 Avg. Ann. Use	18,400	740	32,150	1,290	42,970	1,720	81,840	3,270	
Snow Skiing (Alpine)	Acres-300 Avg. Ann. Use	54,580	180	91,580	300	113,020	380	187,740	630	
Sledding, Tobogganing, Inners tubing	Acres-1,000 Avg. Ann. Use	0	0	3,090	3	5,780	6	15,880	160	
Cross-Country Skiing	Miles of Trail-90 Avg. Ann. Use	0	0	1,020	10	2,050	20	5,710	60	
Snowmobiling	Miles of Trail-250 Avg. Ann. Use	0	0	290	1	620	2	1,700	7	

1/ McKinley, Valencia, and Catron Counties.

political (county) boundaries. The proposed actions and programs developed in this study for satisfying the unmet demands, involve only those opportunities that exist within the hydrological (Basin) boundary. Therefore, for some activities, the majority of the unmet demand may occur and could be met outside the Basin boundary. Also, in satisfying unmet demand, consideration is given only to USDA programs. It is recognized that State agencies, other federal agencies, and private enterprise can satisfy a portion of the unmet demands.

ARIZONA

There were three major problems identified for study in the Arizona portion of the Basin. The opportunities for USDA programs in solving each of these problems is discussed below.

The first of these major problems is concerned with a lack of adequate access to areas that are suitable for recreational use. Most of these areas are located on National Forest lands. The Forest Service, through its Road and Trail Development Program, is continually opening areas and providing improved access to these desirable areas. It is believed that with continuation of this, and other Forest Service programs, access problems in the future will be greatly reduced.

The second of these major problems is concerned with recreation areas that are underused because of a lack of awareness of recreational opportunities or a lack of basic facilities. The Forest Service has an extensive public information program that can disseminate information about the recreational opportunities that exist on the National Forests. Historically, this program has been very successful in informing the public about developed recreation areas. However, many recreational opportunities exist on the National Forests that are not generally known by the public. It is proposed that the Forest Service intensify its public information efforts to continually inform the public of the many recreational activities that are available on the National Forests. The Apache-Sitgreaves National Forests staff is developing a brochure to explain opportunities for dispersed recreation on that forest. These recreation activities include dispersed camping without facilities, four-wheeling and trail bike riding on designated trails, cross-country skiing, snowmobiling, sledding, and other more commonly known activities like camping at developed sites, nature study, hiking, and picnicking.

For ease of presentation, the underuse of existing recreation areas caused by a lack of facilities is addressed under problem three.

The third and last major problem addressed by this study is concerned with overcrowding of existing facilities and the need to identify areas that can be developed into quality recreation areas. This study concern also includes existing recreation areas that are underused because of a lack of basic facilities.

Nine potential developments were originally selected for investigation as a part of this study. These nine sites were selected because of historical or present local interest in development. They are believed to be

representative of the broad range of opportunities that exist in the Basin. Four of these (Hopi Water Based Recreation, Hidden Lake, Trout Lake, and Rio de Flag) were reviewed on a reconnaissance basis and were not investigated further. Hidden Lake, Trout Lake, and the Hopi Water Based Recreation were deleted from more detailed study due to small size of the recreation pools (10-20 acres), and remoteness of the locations. A preliminary investigation report was prepared on Rio de Flag in December 1976. At that time it appeared that an excellent development potential existed for a multipurpose recreation-fish and wildlife development. However, since 1976, conditions in the planning area have changed and it now appears that the water that was to be used for the fish and wildlife developments will be used for other purposes. Without these developments the other features of the project would not be as attractive and would not produce the desired benefits. Consequently, this potential project was not considered any further in this study.

The five remaining sites are believed to have development potential. All five sites are within the Little Colorado River Plateau Resource Conservation and Development Area. This USDA program could provide planning and implementation assistance. A brief discussion of each of these sites follows.

Woodruff Lake Recreation Area

The proposed Woodruff Lake Recreation Area is located in the south-central portion of Navajo County in the northeastern part of Arizona. The town of Woodruff is about 1 mile west of the site. Holbrook, Arizona, and Interstate Highway 40 are about 13 miles north of the site. Woodruff Lake is a natural playa. Sometime prior to 1890, the storage capacity of the lake was increased by the construction of dikes. The lake was filled by diverting water from Silver Creek via a complex conveyance system of siphons, hanging flumes, cable-suspended pipelines, and open ditch. About 30 years ago the conveyance system was abandoned and now the lake is usually dry. Navajo County is studying the reconstruction of this conveyance system so that the lake could be used for recreation and supplemental irrigation. The lake would have a surface area of approximately 150 acres. This study assumes that the lake will be filled prior to the year 1990.

The recommended alternative is a multipurpose plan for water-based recreation and fish and wildlife. Specific fish and wildlife elements include constructing some low islands in the shallow areas of the lake along the southern shore, fencing the area, and seeding the islands and shorelines with suitable food and cover plants for waterfowl. The recreation features of the plan call for the construction of nature trails, a 12-unit campground complete with pad and other associated improvements, a 12-unit picnic area complete with ramadas, grills, and other features, a potable water supply, and sanitary facilities. This development is expected to supply a quality recreation experience for approximately 9,000 visitor days annually.

Woodruff Dam Reservoir Recreation Area

The potential Woodruff Dam or Woodruff Reservoir Recreation Area is located in the south-central portion of Navajo County in the northeastern part of Arizona about 3 miles south of the town of Woodruff. The dam is an existing concrete masonry diversion dam on Silver Creek near the confluence of the Little Colorado River and Silver Creek. The original purpose for this dam was to divert water for irrigation through the irrigation conveyance system described above in the Woodruff Lake proposal. The reservoir area behind the dam, about 2 to 3 surface acres, is almost completely silted-in. There are no basic facilities available; however, the area has a good potential for development as a picnic area for area residents and a camping area for tourists and state residents on vacation.

The recommended development for this site would be to construct a small picnic area, six tables with ramadas and other associated items; a small camping area, six campsites with pads and other associated items; a potable water supply; and sanitary facilities. This development will provide about 4,500 visitor days of recreation annually.

Ganado Recreation Development

The potential Ganado Recreation Development is located in central Apache County in the northeastern part of Arizona on the Navajo Indian Reservation near Ganado, Arizona. There is an existing dam and lake at Ganado. This is an offstream structure and the lake is filled by diverting water from the Pueblo Colorado Wash. The lake has a maximum storage capacity of 3,800 acre-feet with 360 surface acres. Ganado Dam was built as part of the irrigation facilities for providing water to cropland around Ganado. Present irrigated acreage around Ganado is less than 100 acres. There is evidence of excessive seepage through the dam and foundation.

The recommended plan for the Ganado Recreation Development includes constructing a multiple-purpose dam across the Pueblo Colorado Wash about 2,000 feet south of the existing dam. Associated recreation facilities and an irrigation outlet structure will also be provided as part of the plan. The lake would have a recreation pool of 670 surface acres. Total storage capacity of the dam would be 24,000 acre-feet. Planned recreational facilities include a fully developed 100-unit camping area, a 40-unit picnic area, hiking trails, a marina, and associated water supply and sanitary facilities. An estimated 301,000 visitor days annually would be supplied by this facility.

Red Lake Recreation Development

Red Lake is located on Indian Route 12 about 1 mile north of the town of Navajo, New Mexico. The Arizona-New Mexico state line passes through the western portion of the lake with most of the lake located on the New Mexico side. The reservoir is located within the Navajo Indian Reservation in Apache County, Arizona and McKinley County, New Mexico.

Red Lake was one of the first irrigation projects constructed on the Navajo Reservation. The original dam and diversion works were con-

structed in 1885. In 1952, the Red Lake Dam was raised and lengthened to increase the surface area of the lake from 640 acres to 908 acres. Presently the lake is used to irrigate about 150 acres of cropland and for incidental fishing. Fishing use is estimated at about 3,000 fishing days per year.

The recommended plan for Red Lake includes improving access to the lake and constructing basic recreation facilities. These facilities include a fully developed 24-unit campground, a fully developed 12-unit picnic area, a water supply, a boat ramp, and sanitary facilities. It is estimated that this development would accommodate about 20,200 additional visitor days annually.

McHood Park Recreation Development

McHood Park is located in west-central Navajo County about 5 miles south of Winslow, Arizona and Interstate Highway 40. There is an existing dam on Clear Creek which impounds a lake of about 20 surface acres. Navajo County and the City of Winslow constructed a new dam downstream from the existing structure with funds from the Arizona Outdoor Recreation Coordinating Commission. The new lake has a surface area of about 55 acres. The lake filled in May 1980; however, the dam failed on June 12, 1980, and has not been repaired as of this writing.

The International Engineering Company, Phoenix Area Office, has developed a master recreation plan for McHood Park. The preliminary concept, design, and costs presented in this draft master plan were used to develop the recommended plan.

The recommended plan is to construct quality recreation facilities around the lake. These facilities include a dining ramada, fully developed camping areas to accommodate 144 travel trailers and 25 tent sites, 40 picnic tables with ramadas and other features, boat ramps and dock, 3 swimming beaches, a potable water supply, and sanitary facilities. This development is expected to provide a quality recreation experience for about 68,400 visitor days of use each year.

Additional Opportunities

The five proposed developments were the only sites investigated during this study. This does not mean that additional opportunities do not exist. There are numerous existing small lakes within the Arizona portion of the Basin that could support significant amounts of recreation use if basic facilities were available. Since considerable unmet demand exists, the potential of developing these lakes as water-based recreation areas should not be overlooked just because they were not specifically investigated in this study.

There is also potential to build a few new dams within the Basin. One such potential is the Cottonwood Wash Watershed Project. This project is being planned under the authorities of PL 83-566. To avoid duplication of effort, this potential was not included in this study.

Appendix II, Section 4, Development of Surface Water Resource, for this Basin Study, also identifies other potential water development sites that could include recreation as a purpose. Each of these sites, and other sites that might be identified at a later date, should be considered for inclusion of recreation as a purpose.

NEW MEXICO

There are two specific problems identified for study in the New Mexico portion of the Basin. The opportunities for USDA programs in solving each of these problems is discussed below.

The first of these problems is concerned with identifying areas that have potential for development as water-based recreation areas. Studies did not indicate any potential development sites in New Mexico; other than the Red Lake development discussed under Arizona.

The second problem is concerned with the need to increase public awareness of the recreational opportunities for dispersed recreation. The Forest Service has an excellent public information program, as was previously discussed in the Arizona narrative. It is proposed that the Forest Service intensify its public information efforts to continually inform the general public that the opportunities for dispersed recreation on National Forest lands are almost unlimited.

IMPACTS OF USDA OPPORTUNITIES

There are no new projects or programs proposed for the New Mexico portion of the Basin. Consequently, the existing and projected supply, demand, and unmet demand previously shown in Tables 2A and 3A will remain unchanged and impacts will not accrue.

The five proposed recreational developments in the Arizona portion of the Basin were evaluated as potential Resource Conservation and Development Project (RC&D) Measures and will produce measurable impacts. It is proposed that all five of these potential measures be installed prior to the first projection year, 1990. The projected supply, demand, and unmet demand for the projected years 1990, 2000, and 2020, with these measures installed is shown in Table 1-4.

The combined impacts of the proposed actions are shown in Tables 1-5 to 1-8. Table 1-5 displays the impacts on national economic development; Table 1-6 shows the impacts on the environmental quality; Table 1-7 shows the impact on the regional economy; and Table 1-8 shows the impacts on social well-being.

Two alternative plans were investigated for each of the potential developments in addition to the recommended plan. These two alternatives are a plan that emphasized environmental quality and a plan that tended to maximize national economic development. Table 1-9 is a summary comparison of the differences between the NED, EQ, and recommended plans.

TABLE 1-4 - Projected Supply, Demand, and Unmet Recreation Demand, Future With Plan Conditions,
In Activity Occasions, Little Colorado River Basin

Arizona Three County Area 1/

Activity	Projected - 1990			Projected - 2000			Projected - 2020		
	Supply	Demand	Unmet Demand	Supply	Demand	Unmet Demand	Supply	Demand	Unmet Demand
Fishing	928,400	1,418,000	489,600	928,400	1,730,600	802,200	928,400	2,407,000	1,478,600
Picnicking	799,100	1,186,500	387,400	815,800	1,448,000	632,200	857,400	2,009,000	1,151,600
River and Lake Swimming	425,500	507,500	82,000	425,500	619,400	193,900	425,500	859,700	434,200
Camping - No Facilities	978,300	1,035,800	57,500	1,163,200	1,264,000	100,800	1,534,200	1,754,800	220,600
Hike - Backpacking	804,000	967,500	163,500	838,600	1,180,700	342,100	906,400	1,638,100	731,700
Nature Study	1,005,000	1,048,100	43,100	1,178,200	1,279,000	100,800	1,549,200	1,773,700	224,500
Camping - With Facilities	803,800	1,069,700	265,900	853,800	1,305,300	451,500	978,800	1,807,000	828,200
Four-Wheeling	255,400	307,400	52,000	289,300	375,200	85,900	362,500	521,500	159,000
Power Boating - No Skiing	184,200	279,500	95,300	184,200	341,100	156,900	184,200	474,100	289,900
Power Boating - With Skiing	58,300	83,300	25,000	58,300	101,700	43,400	58,300	141,300	83,000
Trail Bike	106,500	128,600	22,100	120,800	157,000	36,200	151,500	218,400	66,900
Canoe, Sail, or Row Boating	119,800	157,900	38,100	119,800	192,700	72,900	119,800	267,900	148,100
Snow Ski	199,400	256,400	57,000	199,400	312,900	113,500	419,400	435,500	16,100
Sled - Toboggan	108,600	113,700	5,100	128,600	138,700	10,100	172,200	193,100	20,900
Cross-Country Skiing	89,200	91,600	2,400	98,200	111,800	13,600	113,700	155,600	41,900
Snowmobiling	174,000	199,000	25,000	209,200	242,900	33,700	284,400	337,000	52,600

1/ Apache, Navajo, and Coconino Counties.

TABLE 1-5 - National Economic Development Account
Recommended Recreational Developments
Little Colorado River Basin - Arizona

Components	Measures of Effects	Components	Measures of Effects
	(Avg. Ann. $\frac{1}{1}$ Dollars)		(Avg. Ann. $\frac{1}{1}$ Dollars)
Beneficial Effects:		Adverse Effects:	
A. The value to users of increased outputs of goods and services:		A. The value of resources required for the plans:	
1. Recreation	1,269,835	1. Five recommended recreational projects	
2. Irrigation	16,200	a. Project installation	753,400
3. Utilization of unemployed and underemployed labor resources for project installation		b. OM&R	203,920
4. Fish and wildlife	55,925	2. Project administration	69,720
	2,890		
		B. Losses in output resulting from external diseconomies:	
		1. Indirect activities from reservoir and facilities take area	350
Total Beneficial Effects	1,344,850	Total Adverse Effects	1,027,390
		Net Beneficial Effects	317,460

$\frac{1}{1}$ 100 years at 7 $\frac{3}{8}$ percent interest.

TABLE 1-6 - Environmental Quality Account
Recommended Recreational Developments
Little Colorado River Basin - Arizona

<u>Components</u>	<u>Measures of Effects</u>
Beneficial and Adverse Effects:	
A. Areas of Natural Beauty	<ol style="list-style-type: none"> 1. Convert 410 acres of semiarid land to recreation facilities. 2. Inundate a 360 acre lake, 2 acres of grass and 353 acres of semi-arid rangeland. 3. Provide access to a full irrigation water supply for about 400 acres of irrigable land; providing a green color contrast in a semiarid area. 4. Replace an existing 360 surface acre lake with a 715 surface acre lake. 5. Disruption in tranquility of rural environments by 403,123 recreation visitor days annually.
B. Quality Considerations of Water, Land, and Air Resources	<ol style="list-style-type: none"> 1. Temporary lowering of air quality during construction of the developments. 2. Slight lowering of air quality during the recreation season throughout the life of the project caused by the influx of recreationists. 3. Stop the slight, but continual, deterioration of land resources around the existing reservoirs that is caused by uncontrolled recreation use. 4. Maintain water quality in Red Lake.

ComponentsMeasures of EffectsC. Biological Resources and
Selected Ecosystems

1. Maintain existing waterfowl habitat on north end of Red Lake.
2. Improve vegetative cover on 293 acres of semiarid land in McHood Park.
3. Provide 7.5 miles of nature trails for controlled viewing of wildlife and vegetation of the Basin.
4. Provide 30 acre wildlife habitat development for the protection and preservation of wildlife and waterfowl.
5. Improve and create habitat for cold and warm water fish, 715 surface acres.
6. Increase resting area for waterfowl by 355 surface acres of water.

D. Irreversible or Irretrievable
Commitments

1. Conversion of 353 acres of semi-arid range and 2 acres of grassland to reservoir area.
2. Conversion of 410 acres of semi-arid range to recreation facilities.
3. Labor materials and energy used in construction of the projects.

TABLE 1-7 - Regional Development Account
Recommended Recreational Developments
Little Colorado River Basin - Arizona

Components	Measure of Effects		Measures of Effects	
	State of Arizona	Rest of Nation	State of Arizona	Rest of Nation
	(Avg. Ann. Dollars)1/		(Avg. Ann. Dollars)1/	
Income:				
Beneficial Effects:				
A. The value of increased output of goods and services to users residing in the region:				
1. Recreation	1,091,875	177,960		
2. Irrigation	16,200	-		
3. Fish and Wildlife	2,460	430		
4. Utilization of regional unemployed or underemployed labor resources from project construction	55,925	-		
5. Additional wages and salaries accruing in the region from implementation of the plans				
a. Recreation service sector	181,500	-181,500		
B. The value of output to users residing in the region from external economies:				
1. Indirect and induced activities associated with utilization of regional unemployed and underemployed and other labor resources				
a. Recreation service sector	128,050	-128,050		
Total Beneficial Effects	1,476,010	-131,160		
Adverse Effects:				
A. The value of resources contributed from the region to achieve the outputs:				
1. Three single purpose and two multiple purpose recreation developments				
a. Project installation			361,280	392,160
b. Project OM&R			203,920	-
2. Project administration			17,920	51,800
B. Losses of output resulting from external diseconomies to users residing in the region:				
1. Indirect activities associated with reservoir take area			350	-
C. Loss of assistance payments from sources outside the region to otherwise unemployed or underemployed resources:				
1. Loss of welfare payments			15,500	+15,500
Total Adverse Effects			578,970	428,460
Net Beneficial Effects			877,040	-559,620

1/ 100 years at 7 3/8 percent interest.

TABLE 1-7 (Continued) - Regional Development Account
Recommended Recreational Developments
Little Colorado River Basin - Arizona

Components	Measure of Effects		Measures of Effects	
	State of Arizona	Rest of Nation	State of Arizona	Rest of Nation
Employment:				
Beneficial Effects:				
A. Increase in number and type of jobs				
1. Employment in project construction	89.5 man-years skilled employment; 45.8 man-years semi-skilled employment	-89 man-years skilled employment		
2. Employment for project OM&R	3 full-time permanent semi-skilled jobs; 11 permanent seasonal semi-skilled jobs	-		
3. Employment in recreation service sector	38 seasonal semi-skilled jobs			
Total Beneficial Effects	89.5 man-years skilled employment; 45.8 man-years semi-skilled employment; 3 full-time permanent semi-skilled jobs; 49 seasonal semi-skilled jobs	-89 man-years skilled employment		
Employment:				
Adverse Effects:				
A. Decrease in number and type of jobs				
Total Adverse Effects				
Net Beneficial Effects			89.5 man-years skilled employment; 45.8 man-years semi-skilled employment; 3 full-time permanent semi-skilled jobs; 49 seasonal semi-skilled jobs	-89 man-years skilled employment

TABLE 1-7 (Continued) - Regional Development Account
Recommended Recreational Developments
Little Colorado River Basin, Arizona

Components	Measures of Effects	
	State of Arizona	Rest of Nation
Population Distribution:		
Beneficial Effects	Creates 3 permanent full-time semi-skilled jobs and 49 permanent seasonal semi-skilled jobs in the predominantly rural river basin three county area that has experienced a 28 percent increase in population from 1970-1977.	-
Adverse Effects	-	-
Regional Economic Base and Stability:		
Beneficial Effects	Provides access to full season irrigation water supply for about 400 acres of cropland. Creates 3 permanent full-time semi-skilled jobs, 49 permanent seasonal semi-skilled jobs, and 135.3 man-years of construction employment in the three county river basin area. This area has an unemployment rate of 8 percent, June 1977. Two of the potential projects are on the Navajo Indian Reservation. This reservation has an unemployment rate of 65 percent, August 1978.	-
Adverse Effects	-	-

TABLE 1-8 - Social Well-Being Account
Recommended Recreational Development
Little Colorado River Basin

<u>Components</u>		<u>Measures of Effects</u>		
Beneficial and Adverse Effects:				
A. Real income distribution	1.	Creates 52 low to medium income, permanent and seasonal, jobs for area residents.		
	2.	Creates regional income benefit distribution of \$1,476,010 by income class as follows:		
		<u>Income Class (Dollars)</u>	<u>Percentage of Persons With Adjusted Gross Income in Class</u>	<u>Percentage Benefits in Class</u>
		< \$3,000	24.3	.439
		\$3,000 - \$10,000	43.5	.322
	> \$10,000	32.2	.239	
	3.	Local costs to be borne by region total \$598,970 with distribution by income class as follows:		
		<u>Income Class (Dollars)</u>	<u>Percentage of Persons With Adjusted Gross Income in Class</u>	<u>Percentage Contributions in Class</u>
		< \$3,000	24.3	9.7
		\$3,000 - \$10,000	43.5	45.9
		> \$10,000	32.2	44.4
B. Recreational Opportunities	1.	Creates 403,123 recreational visitor-day activities for tourists and region residents.		
C. Life, Health, and Safety	1.	Eliminate potentially unsafe conditions associated with a dam that apparently has excessive seepage through the dam and through the foundation materials under the dam.		

TABLE 1-9 - Summary Comparisons of Differences Between the NED, EQ, and Recommended Plans
Five Proposed Recreation Developments. Little Colorado River Basin, Arizona

Account	NED Plan	EQ Plan	Recommended Plan	Differences	
				Recommended Plan Less NED Plan	Recommended Plan Less EQ Plan
National Economic Development					
Beneficial Effects	\$1,346,050	\$1,231,450	\$1,344,850	\$ -1,200	\$ +113,400
Adverse Effects	1,026,090	1,034,990	1,027,390	+1,300	-7,600
Net Beneficial Effects	319,960	196,460	317,460	-2,500	+121,000
Environmental Quality					
Beneficial and Adverse Effects					
B. Quality considerations of water, land, and air resources	1. Lower water quality in Red Lake.	1. Maintain water quality in Red Lake.	1. Maintain water quality in Red Lake.	1. +Maintained water quality in Red Lake.	1. --
C. Biological resources and selected ecosystems					
1. --	1. Create 30-acre wildlife development at Woodruff Lake.	1. Create 30-acre wildlife development at Woodruff Lake.	1. Create 30-acre wildlife development at Woodruff Lake.	1. +30-acre wildlife development at Woodruff Lake.	1. --
2. --	2. Create 100-acre wildlife development at Ganado Lake.	2. Create 100-acre wildlife development at Ganado Lake.	2. --	2. --	2. -100-acre wildlife development at Ganado Lake.
Regional Development					
State of Arizona					
A. Income					
Beneficial Effects	\$1,477,060	\$1,378,510	\$1,476,010	\$ -1,050	\$ +97,500
Adverse Effects	598,320	603,270	598,970	+650	-4,300
Net Beneficial Effects	878,740	775,240	877,040	-1,700	+101,800
B. Employment					
Employment for project construction	45.8 man-years semi-skilled employment	48.5 man-years semi-skilled employment	45.8 man-years semi-skilled employment	--	-2.7 man-years semi-skilled employment

TABLE 1-9 (Continued) - Summary Comparisons of Differences Between the NED, EQ, and Recommended Plans
Five Proposed Recreation Developments, Little Colorado River Basin, Arizona

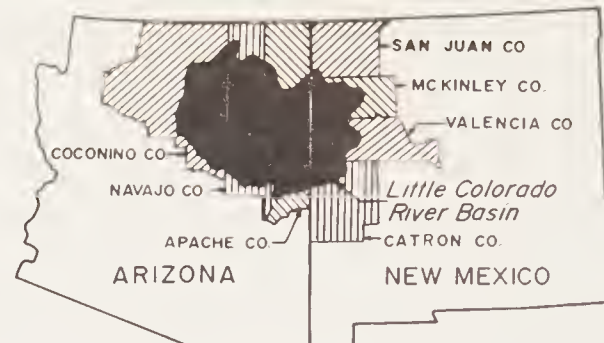
Account	NED Plan	EQ Plan	Recommended Plan	Differences	
				Recommended Plan Less NED Plan	Recommended Plan Less EQ Plan
Social Well-Being					
B. Recreation Opportunities	Creates 403,504 recreation visitor-day activities for tourists and region residents	Creates 367,123 recreation visitor-day activities for tourists and region residents	Creates 403,123 visitor-day activities for tourists and region residents	-381 recreation visitor days use	+36,000 recreation visitor days use

GLOSSARY

Recreation Day - A unit of measurement consisting of a visit by one individual to a recreation development or area for recreation purposes during a 1-hour time period or all of a 24-hour period. It is generally assumed that the average person participates in 1.5-2.5 activities during an average visit to a recreation area. Therefore, a range of 1.5-2.5 activity occasions equals one recreation day.

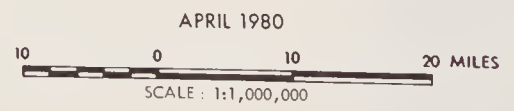
Visitor Day - Consists of an aggregate of two visitor hours. A visitor hour is the presence of one or more persons for recreation purposes in a recreation area for continuous, intermittent, or simultaneous periods of time aggregating 1 hour.

Activity Occasion - Participation by an individual in any one recreation activity during all or part of a 24-hour period.



- LEGEND
- 1 Rio de Flog Recreation Area
 - 2 Mc Hood Park Recreation Area
 - 3 Hopi Recreation Lake Area
 - 4 Woodruff Dom Recreation Area
 - 5 Woodruff Lake Recreation Area
 - 6 Ganado Lake Recreation Area
 - 7 Hidden Lake Recreation Area
 - 8 Trout Lake Recreation Area
 - 9 Red Lake Recreation Area
 - 10 McGoffey Lake Recreation Area
 - 11 Quemodo Lake Recreation Area

RECREATION SITES
LITTLE COLORADO RIVER BASIN
ARIZONA AND NEW MEXICO



Note:
The boundary as shown for the Hopi Indian Reservation does not reflect division of the joint use area resulting from the Navajo - Hopi Settlement Act of Dec. 22, 1974, P.L. 93-531. Final boundaries have not been determined as of this printing.

Source:
Base map prepared by SCS, WTSC Carto Unit from USGS 1:500,000 series.
Thematic detail compiled by state staff.
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE
USDA SCS-PORTLAND, OR 1980

SECTION 2
FISH AND WILDLIFE

SECTION 2

FISH AND WILDLIFE

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SECTION 2

FISH AND WILDLIFE

INTRODUCTION

Wildlife includes all non-domestic animal life and is considered a basic resource. Wildlife has many values. Although hunting is normally considered the primary recreational and economic benefit from wildlife; observations, photography, and nature studies are also important. Insect control, rodent control, carrion removal, and flower pollination are some biological values of wildlife.

The number of wildlife species and the population numbers of each species are determined by the following ecosystem components: vegetation, climate, soil, water, animal life, human activities, and disease.

Habitat is classified according to climate, soils, and vegetation. The Little Colorado River Basin has seven different habitat classifications. (Refer to Vegetation Communities Map, following page 2-2, and habitat descriptions listed below).

The effects of man's past activities and land use practices have in many cases reduced and degraded the habitats of fish and wildlife. Long periods of heavy grazing by domestic livestock have resulted in the reduction of preferred forage plants utilized by wildlife.

Expansion of human population and great increases in recreational activities that have brought people into remote areas have in some cases generated conflicts and competition with the historical use of these areas by wildlife. Human-caused pollution in the forms of sediments and domestic sewage has lowered the capacity of many aquatic ecosystems to support desirable fish populations.

PRESENT SITUATION

HABITAT DESCRIPTIONS

The habitats correspond with the vegetative communities as mapped and described by Brown & Lowe (7). For a more complete list of the wildlife associated with each vegetative community, refer to the USDA Forest Service RUN WILD computer program.

Alpine Tundra

There is very little of this type of habitat in the report area. It is confined to the highest peaks in the San Francisco Mountains. It occurs between 11,000 and 12,670 feet elevation. Fifty species of plants are found in the type. Twenty of these are Arctic disjuncts. Only two vertebrates breed in the tundra in Arizona. These are the American pipit and the deer mouse. Little management is possible. Total protection and/or preservation is recommended.

Associated Species:

Plants

avens - Geum turbinatum
tundra saxifrage - Saxifraga caespitosa
circumpolar cinquefoil - Potentilla sibbaldi
tundra bluegrass - Poa rupicola
alpine fescue - Festuca ovina
tundra sedge - Carex ebenea

Animals

American pipit - Anthus spinoletta
deer mouse - Peromyscus maniculatus

Spruce-Alpine Fir Forest

Spruce-alpine fir forests are well shaded by the dense stands of trees. Shrubs, forbs, and grasses are nearly absent under the tree canopy and are found mainly in open areas within the type. Broadleaf deciduous trees occur where the canopy is open, or as riparian corridors. Elevations range from 9,500 to 11,000 feet.

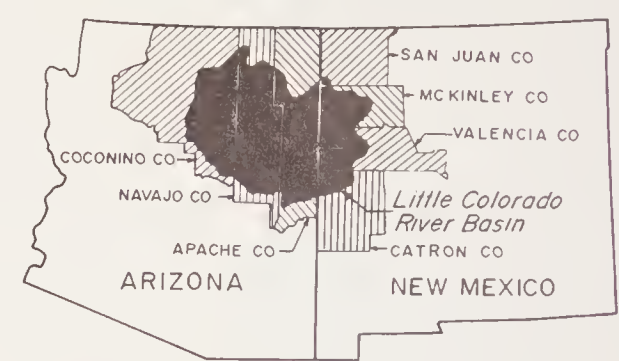
Associated Species:

Plants

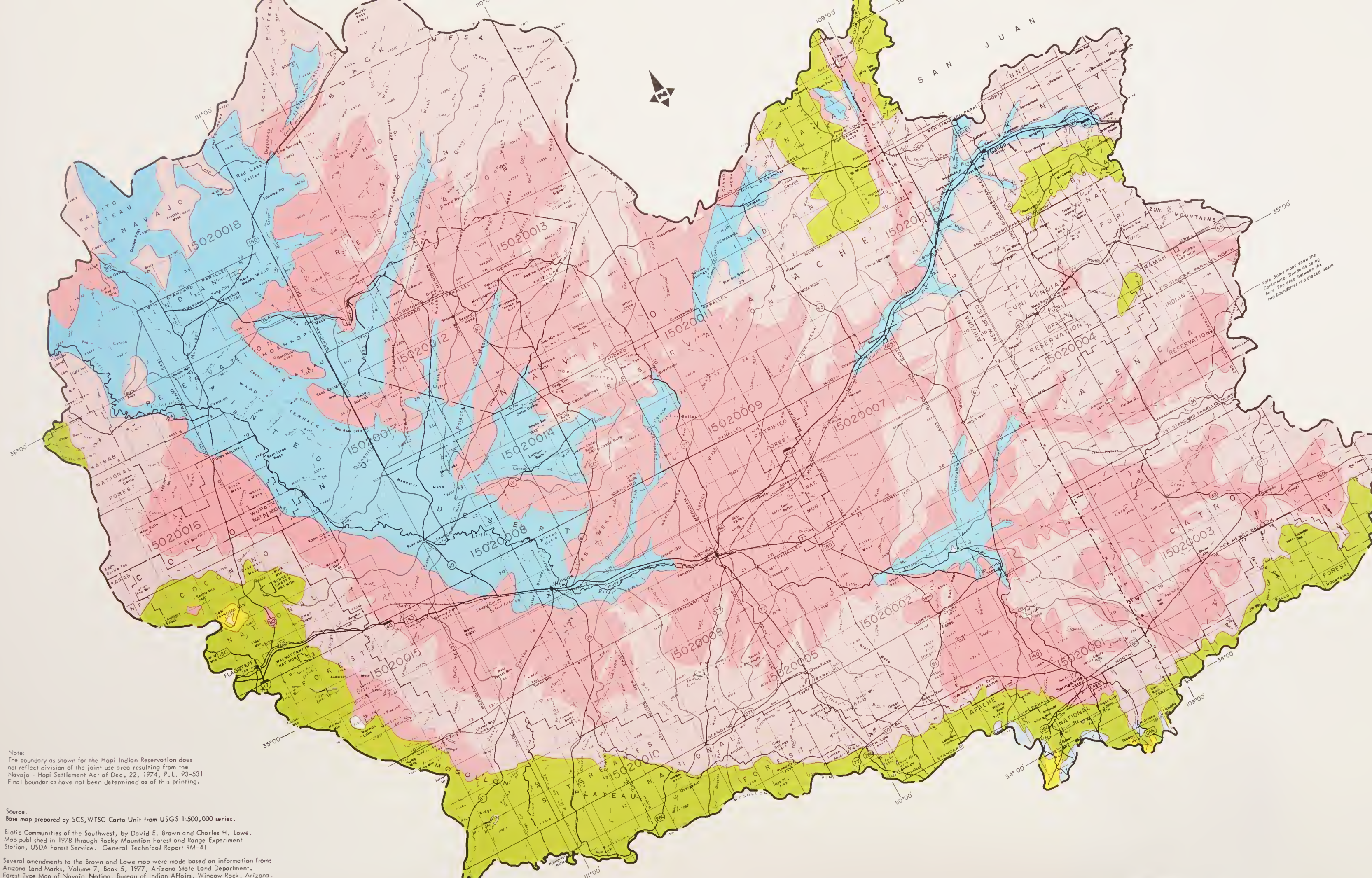
Engelmann spruce - Picea engelmannii
blue spruce - Picea pungens
alpine fir - Abies lasiocarpa
white fir - Abies concolor
Douglas-fir - Pseudotsuga menziesii v. glauca
bristlecone pine - Pinus aristata
limber pine - Pinus flexilis
dwarf juniper - Juniperus communis
thinleaf alder - Alnus tenuifolia
quaking aspen - Populus tremuloides
Sculer's willow - Salix scouleriana
water birch - Betula occidentalis

Animals

chickaree squirrel - Tamiasciurus hudsonicus
red-backed mouse - Clethrionomys gapperi
long-tailed weasel - Mustella frenata
least chipmunk - Eutamias minimum
blue grouse - Dendragapus obscurus
Canada jay - Perisoreus canadensis
Clark's nutcracker - Nucifraga columbiana
elk - Cervus canadensis
brown creeper - Certhia familiaris
black bear - Euarctos americanus
blue grouse - Dendragapus obscurus



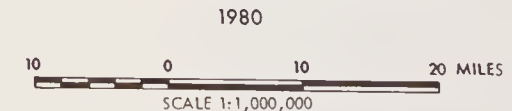
LOCATION MAP



- LEGEND
- Alpine Tundra
 - Spruce-Alpine Fir Forest
 - Montane Conifer Forest
 - Juniper-Pinyon Woodland
 - Plains and Desert Grassland
 - Mountain Meadow Grassland
 - Great Basin Desert Scrub
- 15020004 Hydrologic Unit Code
US Water Resource Council

NOTE: Description of vegetation communities are in the Fish and Wildlife Section of the report.

VEGETATION COMMUNITIES
LITTLE COLORADO RIVER BASIN
ARIZONA AND NEW MEXICO



Note:
The boundary as shown for the Hopi Indian Reservation does not reflect division of the joint use area resulting from the Navajo-Hopi Settlement Act of Dec. 22, 1974, P.L. 93-531. Final boundaries have not been determined as of this printing.

Source:
Base map prepared by SCS, WTSC, Carto Unit from USGS 1:500,000 series.

Biotic Communities of the Southwest, by David E. Brown and Charles H. Lowe.
Map published in 1978 through Rocky Mountain Forest and Range Experiment Station, USDA Forest Service. General Technical Report RM-41.

Several amendments to the Brown and Lowe map were made based on information from:
Arizona Land Marks, Volume 7, Book 5, 1977, Arizona State Land Department.
Forest Type Map of Navajo Nation, Bureau of Indian Affairs, Window Rock, Arizona.

Montane Conifer Forest

Most of this habitat type lies between 6,000 and 9,500 feet elevation, although it sometimes extends downward to 5,000 feet on northfacing slopes and canyons. It also extends to nearly 10,000 feet on southfacing slopes and ridges. Principal trees are evergreen with scatterings of deciduous species (see lists). This type is the most important of the true forests for wildlife. Elk, mule deer, turkey, Abert's squirrel, bear, beaver, and many other wildlife species occur here. Below 8,500 feet, the forest is warmer and drier and is composed mainly of ponderosa pine (fir will be found on northfacing slopes). At mid-elevations, fir and ponderosa pine intermingle, except on northfacing slopes. Firs are dominant on northfacing slopes above 7,500 feet and become increasingly dominant on all slopes above 8,500 feet.

Associated Species:

Plants

ponderosa pine - Pinus ponderosa
Douglas-fir - Pseudotsuga menziesii v. glauca
white fir - Abies concolor
limber pine - Pinus flexilis
Gambel oak - Quercus gambelii
New Mexico locust - Robinia neomexicana
bigtooth maple - Acer grandidentatum
quaking aspen - Populus tremuloides
mountain muhly - Muhlenbergia virescens
pine dropseed - Blepharoneuron tricholepis
blue grama - Bouteloua gracilis
pinyon ricegrass - Piptochaetium fimbriatum
squirreltail - Sitanion hystrix
mountain brome - Bromus marginatus
deergrass - Muhlenbergia rigens
Junegrass - Koeleria cristata
raspberry - Rubus strigosus
snowberry - Symphoricarpos oreophilus
oceanspray - Holodiscus dumosus

Animals

white-tailed deer - Odocoileus virginianus
elk - Cervus canadensis
black bear - Euarctos americanus
mule deer - Odocoileus hemionus
Abert's squirrel - Sciuris aberti
golden-mantled ground squirrel - Citellus lateralis
cliff chipmunk - Eutamias dorsalis
forest cottontail rabbit - Sylvilagus nuttali
deer mouse - Peromyscus maniculatus
turkey - Meleagris gallapavo
Mearns quail - Cyrtonyx montezumae
bandtail pigeon - Columba fasciata
bluegrouse - Dendragapus obscurus

stellar jay - Cyanocitta stelleri
mourning dove - Zenaidura macroura
purple martin - Progne subis
short-horned lizard - Phrynosoma douglassi
mountain king snake - Lampropeltis pyromelana
Arizona green treefrog - Hyla eximia
tiger salamander - Ambystoma tigrinum
mountain lion - Felis concolor

Juniper-Pinyon Woodlands

This habitat type occurs predominantly on plateaus and mesas at elevations between 5,500 feet and 7,500 feet. The pinyon pine predominates below 6,500 feet. The species are alligator, Rocky Mountain, one-seeded, and Utah juniper. Pinyons are the Colorado and single-leaf. Understory vegetation varies with location and past use. Juniper-pinyon is of importance to many species of wildlife as well as livestock. It is particularly important to avoid overuse by livestock on this type of habitat.

Associated Species:

Plants

Colorado pinyon - Pinus edulis
Utah juniper - Juniperus osteosperma
one-seed juniper - Juniperus monosperma
singleleaf pinyon - Pinus monophylla
Rocky Mountain juniper - Juniperus scopulorum
blue grama - Bouteloua gracilis
Arizona fescue - Festuca arizonica
sage brush - Artemisia tridentata
cliffrose - Cowania Mexicana
algerita - Berberis fremonti

Animals

pinyon mouse - Peromyscus truei
bushy-tailed wood rat - Neotoma cinerea
scaled quail - Callipepla squamata
pinyon jay - Gymnorhinus cyanocephalus
mourning dove - Zenaidura macroura
plain titmouse - Parus inornatus
gray vireo - Virio vicinior
gray flycatcher - Empidonax wrighti
black-throated gray warbler - Dendroica nigrescens
mule deer - Odocoileus hemionus
coyote - Canis latrans
bobcat - Lynx rufus
porcupine - Erethizon dorsatum
mountain lion - Felis concolor
pronghorn antelope - Antilocapra americana
cottontail - Sylvilagus nuttali

Plains and Desert Grasslands

Plains grassland refers to a grama-grass dominated short-grass type. Blue, black, sideoats, and other grama species are the main grasses. These plains lie between 5,000 and 7,000 feet elevation and receive 11 to 18 inches of annual precipitation. Shrubs are not a major component (usually 0-5 percent). There have been major invasions of brush on many areas, due mainly to overuse by livestock.

Desert grassland is a highly diverse grass-shrub type. Galleta, three-awn, and black grama are the main grasses. Desert grasslands occur down to 4,000 to 6,000 feet elevation in the 10 to 15-inch precipitation zone. There have been major increases in some shrubs on these grasslands.

Associated Species:

Plants

Indian ricegrass - Oryzopsis hymenoides
sideoats grama - Bouteloua curtipendula
little bluestem - Schizachyrium scoparium
western wheatgrass - Agropyron smithii
blue grama - Bouteloua gracilis
black grama - Bouteloua eriopoda
dropseeds - Sporobolus spp.
squirreltail - Sitanion hystrix
needle and thread - Stipa comata
four-wing saltbush - Atriplex canescens
winterfat - Eurotia lanata
bigelow sage - Artemesia beglovii
Mormon tea - Ephedra viridis
pinyon pine - Pinus edulis
Rocky Mountain juniper - Juniperous scopulorum
yucca - Yucca elata
cholla - Opuntia acanthrocarpa
burroweed - Haplopappus tenuisectus
galleta - Hilaria jamesii
prickly pear - Opuntia chlorotica

Animals

white-tailed prairie dog - Cynomys gunnisoni
white-footed mouse - Peromyscus eucopus
white-throated wood rat - Neotoma albigula
antelope - Antilocapra americana
horned lark - Eremophila alpestris
savannah sparrow - Passerculus sandwichensis
spotted ground squirrel - Citellus spilosoma
blacktail jackrabbit - Lepus californus
prairie rattlesnake - Crotalus viridis
mourning dove - Zenaidura macroura
scaled quail - Callipepla squamata
Gambel quail - Lophortyx gambelii

Mountain Meadow Grassland

This type occurs in relatively small areas that are natural openings in coniferous forests. Their greatest development is in the White Mountains, Apache-Sitgreaves prairies and cienegas, and the Kaibab Plateau. Precipitation is 20 to 35 inches. The meadows vary in elevation from 7,500 to 10,000 feet. These meadows are valuable to many kinds of wildlife because of the food produced within the edge they create in closed canopy forests.

Associated Species:

Plants

mountain timothy - Phleum alpinum
meadow hairgrass - Deschampsia caespitosa
mountain bluegrass - Poa reflexa
Arizona fescue - Festuca arizonica
pine dropseed - Blepharoneuron tricholepis
blue grama - Bouteloua gracilis
needle and thread - Stipa comata
mountain clover - Trifolium fendleri
wild daisy - Erigeron flagellaris
mountain dandelion - Agoseris glauca
yarrow - Achillea lanulosa
phlox - Phlox caespitosa

Animals

pocket gopher - Thomomys talpoides
meadow mouse - Microtus longicaudus
badger - Taxidea taxus
gray-collared chipmunk - Eutamias cinereicollis
black bear - Euarctos americana
mule deer - Odocoileus hemionus
elk - Cervus canadensis
mountain bluebird - Sialia Mexicana
blue grouse - Dendragapus obscurus

Great Basin Desert Scrub

The southwestern limit of the Great Basin Desert Scrub lies primarily in the region north and east of Flagstaff, the Arizona Strip north of Grand Canyon, and along the Utah-Arizona state line. It is a shrub and grass-dominated cold desert. Vegetation is low growing and is often divided into large stands of a single species. This habitat type occurs above 4,000 feet, with an annual precipitation of 7 to 12 inches. There is a shortage of water for both wildlife and livestock. Habitat management usually consists of brush or shrub removal and reseeding to increase forage for livestock. This practice can come into serious conflict with wildlife when brush is cleared on deer, elk, or antelope winter feeding grounds. Fencing of cleared areas often excludes antelope use.

Associated Species:

Plants

big sagebrush - Artemesia tridentata
blackbrush - Coleogyne ramosissima
shadscale - Atriplex confertifolia
horsebrush - Tetradymia canescens
winterfat - Eurotia lanata
Mormon tea - Ephedra viridis
pickleweed - Allenrolfea occidentalis
saltgrass - Distichilis stricta
greasewood - Sarcobatus vermiculatus
Apache plume - Fallugia paradoxa
prickly pear - Opuntia engelmannii
skunkbush sumac - Rhus trilobata
blue grama - Bouteloua gracilis

Animals

Great Basin pocketmouse - Pereognathus parvus
chisel-toothed kangaroo rat - Dipodomys microps
Great Basin shrike - Lanius nevadensis
sage thrasher - Oreoscoptes montanus
sage sparrow - Aimophila belli
sagebrush swift - Sceloporus graciosus
Great Basin rattlesnake - Crotalus viridis lutosus
mule deer - Odocoileus hemionus
antelope - Antilocapra americana
mourning dove - Zenaidura macroura
scaled quail - Callipepla squamata
Gambel quail - Lephortyx gambelii

HABITAT MANAGEMENT

There are eight principal landowners and/or management agencies in the Little Colorado River Basin (see Land Ownership Map in Section 3, following page 3-2). They are: private landowners, Navajo, Hopi, Zuni and Indian tribes, Arizona and New Mexico State Land Departments, U. S. Forest Service, and Bureau of Land Management.

These landowners and administrative agencies have primary responsibility for managing the vegetation and water components of the wildlife habitat on their respective lands. Their decisions regarding livestock grazing, cropland practices, timber harvests, road locations, housing developments, off-road vehicle use, etc., have significant impacts on the habitat of wildlife species. Some wildlife species can adapt to modified habitats while other must move or become extinct in a given locale. Therefore, wildlife habitat considerations should be included when planning and implementing land and water management practices.

Private Lands

Landowners and/or managers make the decisions. When needed, technical assistance from several agencies is available. The Soil Conservation Service assists landowners in the planning and supervision of construc-

tion of wildlife habitat improvements. The State Forestry divisions in cooperation with the Forest Service provide forestry assistance in planning for wildlife habitat considerations. The State Game and Fish Departments can control game population numbers which affect the kinds and amount of vegetative cover.

Financial assistance can be provided to a landowner for habitat improvement works through the Agricultural Stabilization and Conservation Service's cost-share programs. Multipurpose improvements can be funded by the Resource Conservation and Development and Small Watershed programs.

To date, very little direct wildlife habitat work has been accomplished on private lands. Limited benefits to wildlife have resulted indirectly from range and cropland practices.

Navajo, Hopi, and Zuni Reservations

The Bureau of Indian Affairs has the authority and primary responsibility for managing the game and fish resources on Indian lands. They look to the U.S. Fish and Wildlife Service to provide the Tribes with technical support for the execution of fish and wildlife management programs in the field. The Soil Conservation Service provides habitat management planning assistance to the Tribes through Resource Conservation and Development, other cost-share and technical assistance programs.

The Navajo and Zuni Tribes each have fish and game departments which are currently conducting habitat and game population studies as the basis for preparing game management plans.

Arizona and New Mexico State Trust Lands

Under the enabling legislation which provides for the management of these lands, there is no mandate to provide for wildlife habitat consideration. Most of the State trust lands are under lease for various types of revenue generating uses. Benefits to wildlife habitat on State lands are implemented at the option of the lessee and usually occur indirectly from other practices. The State land departments encourage the lessee to provide for wildlife habitat improvements but the Departments cannot provide funds.

National Forest Lands

The objective is to maintain and develop suitable habitat for wildlife and fish by coordination with the management of other National Forest resources. Through coordination with States, the Forest Service carries out direct wildlife and fish habitat improvement measures. Threatened and endangered species receive highest priority.

Each National Forest has one or more wildlife and/or fisheries biologist who participates in planning all activities which could affect fish and wildlife habitat.

Public Lands

Public lands are managed by the Bureau of Land Management (BLM) under the multiple use and sustained yield concepts. The objective is to maintain and develop suitable habitat for fish and wildlife by coordination with the management of other resources. BLM wildlife biologists work in cooperation with the State and other Federal agencies on a wide variety of wildlife habitat improvement programs.

GAME POPULATION MANAGEMENT AND REGULATIONS

Non-Indian Lands

The State Game and Fish Departments manage the game populations. Their objective is to maintain a healthy game population with numbers commensurate with available habitat, and to provide hunting in a manner that is compatible with other land uses. Recommendations from private landowners, sportspersons, and land management agencies along with the departments' game surveys are used to set harvest and hunting season regulations. The hunting and fishing regulations are established annually by the game and fish commissions in each state.

Indian Reservations

The Navajo and Zuni tribal councils establish fishing and hunting regulations for their respective lands. The regulations and number of permits for fishing and harvesting game are based on recommendations of the tribal fish and game departments and the U.S. Fish and Wildlife Service. These recommendations are based on conditions of fisheries, game surveys, and habitat conditions.

The Hopi Tribe currently does not have an approved game ordinance. There are several small deer herds but no hunting is permitted. There are no other big game species on the Hopi Reservations.

All Lands

The U.S. Fish and Wildlife Service has the responsibility on all lands for predator and rodent control, migratory waterfowl, and the Endangered Species Act. They conduct these activities in cooperation with landowners and land management agencies.

ENDANGERED SPECIES

The U.S. Fish and Wildlife Service is responsible for administering the 1973 Endangered Species Act and 1978 amendments. Other Federal and State agencies must be aware of the endangered species, their habitat requirements, and consider the species' needs in all management and project proposals. This consideration is required for all programs involving Federal funds both on Federal and non-Federal lands. Management units have been, or will be, established for each of the endangered species.

The following list of endangered, threatened, and unique species are known to, or are believed to, occur in the Little Colorado River Basin. Unique is a USDA Forest Service classification. It is defined as a species which is not endangered or threatened, but may have considerable scientific, local, or national interest.

TABLE 2-1. List of Endangered, Threatened, and Unique Wildlife ^{1/}

<u>FISH</u>		
<u>Endangered</u>	<u>Threatened</u>	<u>Unique</u>
*Humpback Chub	*Apache Trout	Little Colorado River
**Zuni Mountain Sucker		Speckled Dace
<u>BIRDS</u>		
*Peregrine Falcon		Golden Eagle
*Bald Eagle		Osprey
**Buff-breasted Fly Catcher		Prairie Falcon
		Spotted Owl
		Burrowing Owl
		Goshawk
		Northern Three-toed
		Woodpecker
<u>MAMMALS</u>		
*Black-footed Ferret		Spotted Bat
		Kit Fox
		White-tailed Antelope
		Squirrel
		Arizona Gray Squirrel
		Red Squirrel

1/ January 1979.

* Species on Federal list.

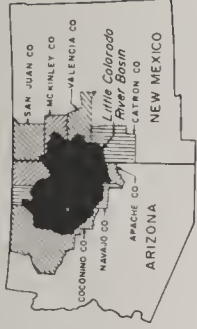
** Species on New Mexico's list.

MANAGEMENT AND HARVESTING OF BIG GAME

Arizona Non-Indian Lands

The Basin study area is within two of Arizona Game and Fish Department's Regions: Region I with offices at Pinetop and Region II with offices at Flagstaff. There are 11 big game management units totally within and two units partially within the Arizona portion of the study area. (Refer to Big Game Management Units Map following page 2-10.)

Wildlife managers conduct annual surveys to determine population characteristics, harvest estimates, mortality, population estimates and trends, range conditions and climatic factors. The survey results are published in yearly Management Information Performance Reports for each big game species.



LOCATION MAP

LEGEND

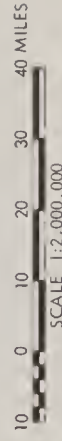
- 3 State Designated Boundary and Unit Number
- 3 Navajo Tribe Designated Boundary and Unit Number

BIG GAME MANAGEMENT UNITS

LITTLE COLORADO RIVER BASIN

ARIZONA AND NEW MEXICO

JANUARY 1980



Source: Base map prepared by SCS, WTSC Carto Unit from USGS 1:500,000 series. Thematic detail prepared by state staff from Arizona Game and Fish Department, New Mexico Department of Game and Fish, and U.S. Department of Agriculture, Soil Conservation Service.

The Planning and Evaluation Branch of the Arizona Game and Fish Department is currently preparing wildlife strategic plans for each big game species. These plans include goals and objectives which are used as a guide for future department management programs. Specific problems which hinder the attainment of goals and objectives have been identified and evaluated. The evaluation process includes review by land management agencies and various public groups.

The following discussion and tables provide information for the major game species.

Mule Deer: The mule deer is the most widely distributed and most popular big game species in the Basin. (See Distribution of Big Game - Mule Deer, following page 2-12). Since the initiation of the permit system in 1971, both the number of hunters and harvest have decreased. The demand for archery hunting is rapidly increasing.

The Arizona Game and Fish Department's goal is to increase the number of mule deer in the state, improve the quality of firearms hunts, and meet demands for archery hunting. The 1985 objectives are to provide for a 10 percent increase in annual harvest, maintain success of firearms hunters at or above 18 percent, and provide hunting opportunities for 12,000 archers.

TABLE 2-2. Summary of Mule Deer Classification and Firearms Deer Harvest Information - Units 1 through 5 and 7 (Basin Area)

Year	Bucks/ 100 Does	Fawns/ 100 Does	Number Hunters	Harvest		Percent Hunter Success
				Mule Deer Bucks	Whitetail Bucks	
1975	26	56	8,987	1,053	73	13
1976	25	54	6,887	967	74	15
1977	25	51	7,339	986	51	14

The primary problems in meeting the goals and objectives for mule deer are:

1. Improved guidelines are needed for determining harvest methods, number of hunters, hunting season, and mule deer population trends.
2. Mortality caused by poaching, illegal kills during season, road kills in a few areas, and predation of fawns by coyotes in a few areas.
3. Developments such as roads, housing, and recreation facilities are reducing available habitat.
4. Fire control practices have led to climax vegetative communities in mule deer habitats resulting in decreased forage and low deer densities.

5. In certain areas, particularly winter and spring ranges, competition for forage between domestic livestock and deer is severe.
6. Mule deer populations have yet to recover from conditions in the early 1960's, when diseases and harvesting of does coincided to drastically reduce numbers. The impacts were particularly severe in the fringe deer areas such as the Little Colorado River Basin.

White-tailed Deer: The distribution of white-tailed deer in the Basin is limited to a few rugged canyon areas and along the top of the Mogollon Rim. (See Distribution of Big Game Map - White-tail deer, following page 2-12.

Management goals, objectives, and problems are very similar to those listed above for mule deer.

Elk: The majority of Arizona's non-Indian land elk habitat is within the forested lands of the Little Colorado River Basin. (See Distribution of Big Game Map - Elk, following page 2-12).

Numbers of elk continue to increase in the areas west of Clear Creek. Populations in the eastern portion of the Basin have remained stable the past several years at a level below the carrying capacity of the range.

Currently, four hunters apply for each available firearm elk permit. By 1985, the demand is expected to increase to 6.5 applicants per firearm permit. The demand for archery elk permits is expected to increase 8 percent annually.

The Arizona Game and Fish Department's goal for elk management is to maintain populations at optimum numbers in relation to the carrying capacity of the habitat while increasing opportunities for recreational hunting. Specific 1985 objectives are to: reduce the numbers of any elk permits in Apache and Navajo Counties to provide for an increase in the number of cow elk, maintain current populations in Coconino County, meet the projected demand for archery hunting, and coordinate with the land managing agencies to provide for measurable improvement in range conditions.

TABLE 2-3. Summary of Elk Classification and Harvest Information, Units 1 Through 5 and 7 (Basin Area)

<u>Year</u>	<u>Bulls/ 100 Cows</u>	<u>Calves/ 100 Cows</u>	<u>Number Hunters</u>	<u>Elk Harvested</u>	<u>Percent Hunter Success</u>
1975	35	57	3,594	567	16
1976	38	61	3,722	652	18
1977	40	58	3,908	672	17



LOCATION MAP

LEGEND

- Medium (5.1-10.0*)
- Low (3.1-5.0*)
- Sparse (0.1-3.0*)
- Very Infrequent
- Critical habitat area in New Mexico

* Estimated number of deer per section



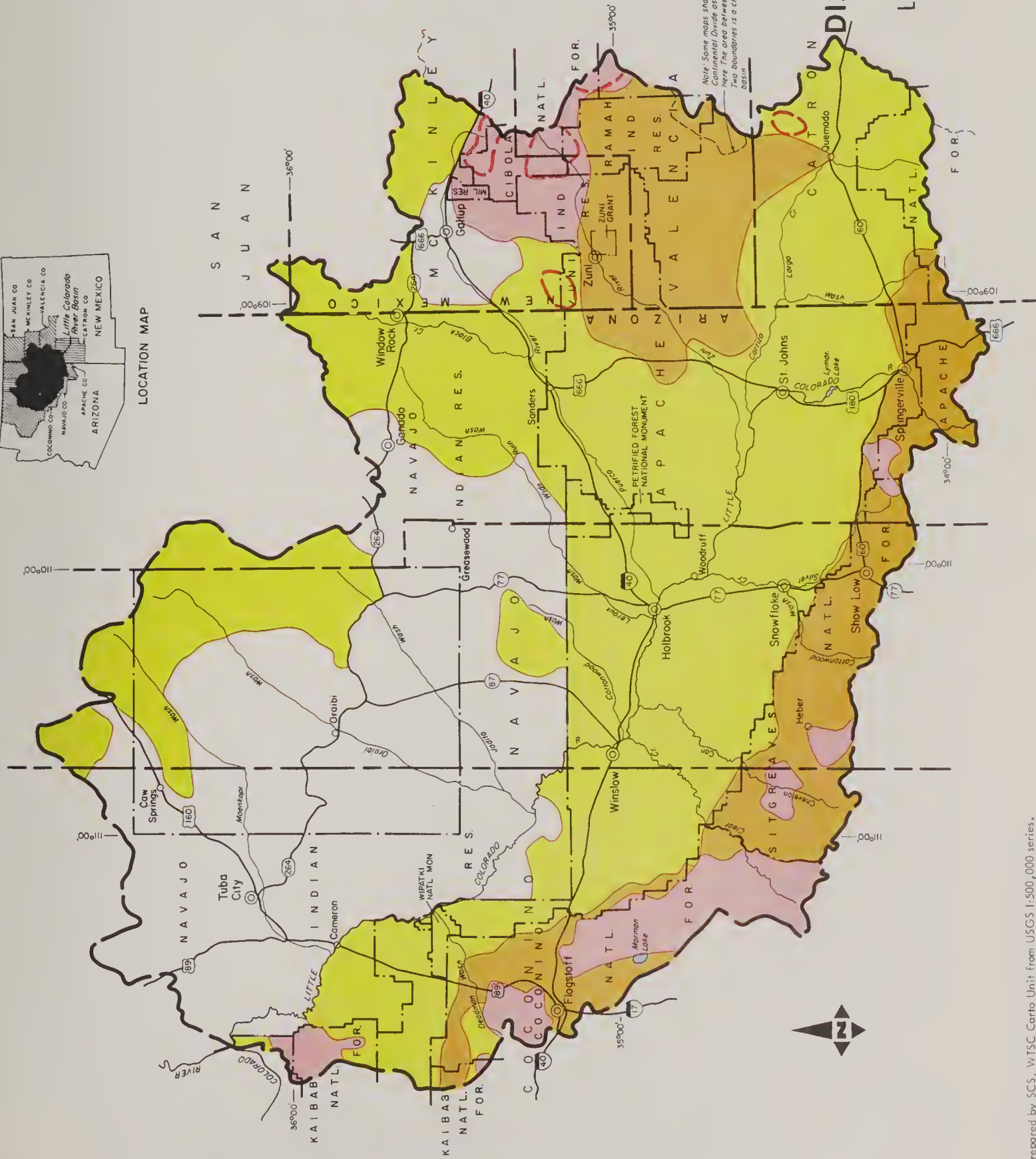
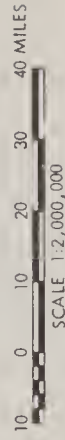
DISTRIBUTION OF BIG GAME

MULE DEER

LITTLE COLORADO RIVER BASIN

ARIZONA AND NEW MEXICO

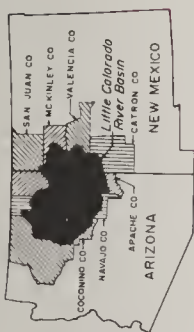
JANUARY 1980



Source: Base map prepared by SCS, WITSC Carto Unit from USGS 1:500,000 series. Thematic detail compiled by state staff from Arizona Game and Fish Department New Mexico Department of Game and Fish Branch of Fish and Wildlife, Navajo Tribe U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

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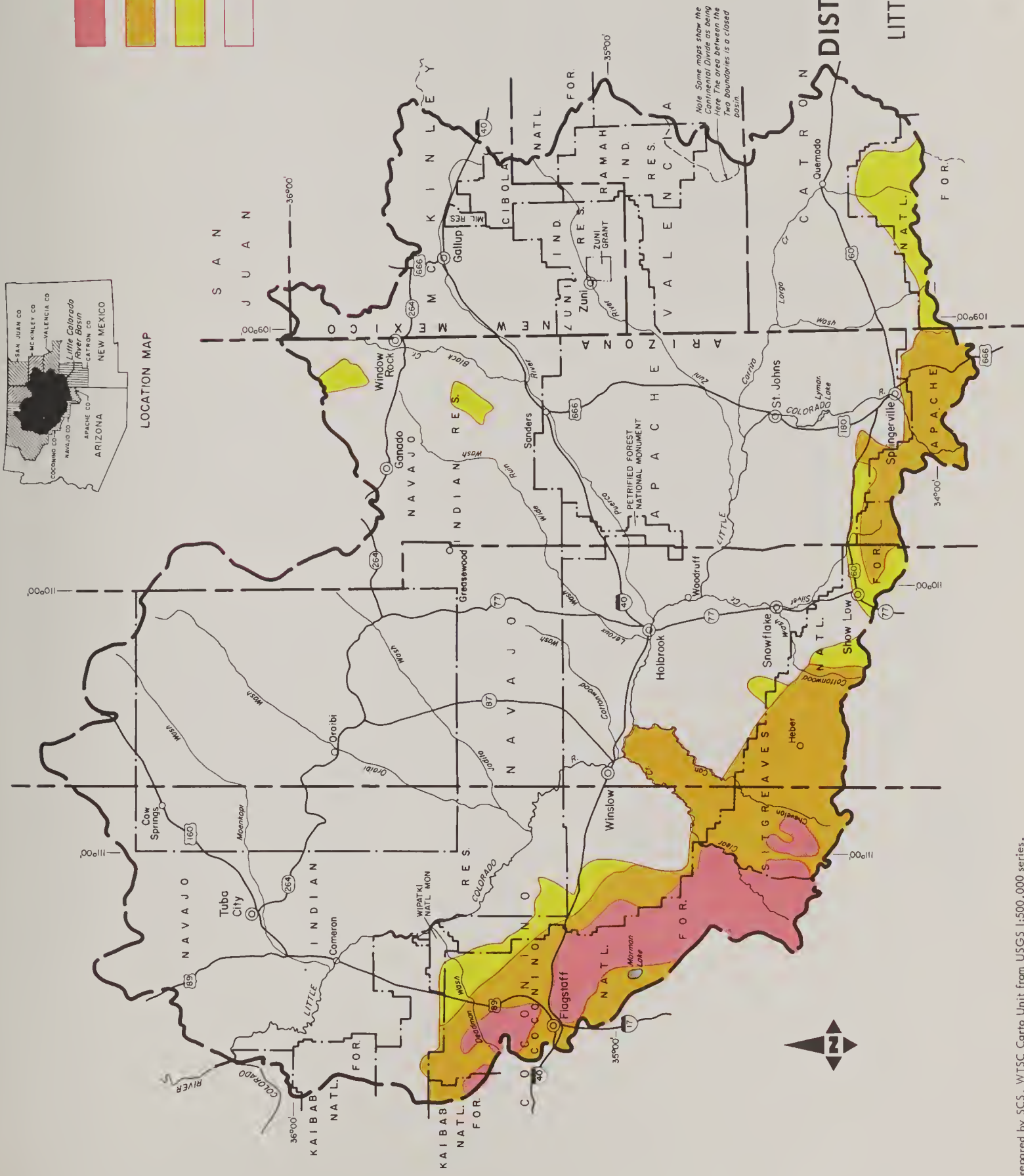
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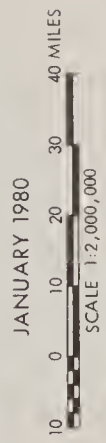
LEGEND



* Estimated Number of Elk per Section



DISTRIBUTION OF BIG GAME
ELK
LITTLE COLORADO RIVER BASIN
ARIZONA AND NEW MEXICO



JANUARY 1980

Source: Base map prepared by SCS, WTSC Carto Unit from USGS 1:500,000 series. Thematic detail compiled by state staff from Arizona Game and Fish Department New Mexico Department of Game and Fish Branch of Fish and Wildlife, Navajo Tribe U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

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The primary problems in meeting the goal and objectives for managing elk are:

1. Conifer invasion and summer home developments are degrading critical mountain meadows used by elk.
2. Determining the optimum population levels for elk herds which will be commensurate with habitat and other uses of the land.
3. Determining the best guidelines for coordinating land use practices, such as timber, range, and recreation, with elk habitat requirements. The effects on elk of livestock grazing systems as currently practiced are not quantified.
4. Determining the extent of elk herd ranges and, as needed, adjust management unit boundaries.
5. Poaching throughout the year and illegal killing of elk during the hunting season is reducing numbers in some areas.
6. In some mountain meadows and on some winter ranges, competition for forage between domestic livestock and elk is severe.
7. Fire management in conifer forests has altered elk habitat.

Pronghorn Antelope: Some of the best antelope habitat in Arizona is within the Little Colorado River Basin. (See Distribution of Big Game Map - Antelope, following page 2-14). Anderson Mesa, southwest of Flagstaff, supports a good antelope herd. However, antelope populations are readily affected by climatic conditions and predator populations. Census counts reflect a decrease in numbers. Wildlife managers attribute this to severe winters, drought, and predation.

Demand for firearms hunting and interest in observing and photographing antelope is expected to increase by about 5 percent per year. The State's goal is to increase the number of pronghorn antelope and maintain a conservative hunting program. Objectives to be met by 1985 are a 20 percent increase in population and maintain harvest at the current level.

TABLE 2-4. Summary of Antelope Classification and Harvest Information, Units 1 Through 5 and 7 (Basin Area)

<u>Year</u>	<u>Survey Counts</u>	<u>Bucks/ 100 Does</u>	<u>Fawns/ 100 Does</u>	<u>Number Hunters</u>	<u>Number Harvested</u>	<u>Percent Hunter Success</u>
1975	1,507	24	31	436	235	54
1976	1,422	32	24	348	204	59
1977	1,212	30	32	326	183	56

The problems which must be addressed in meeting the goal and objectives are:

1. Low survival of antelope fawns.
2. The interrelationship between pronghorns and cattle has not been established.
3. Guidelines for determining harvest methods, numbers of hunters, hunting seasons, and pronghorn population trends are needed.
4. A large percentage of antelope habitat on State, private, and Indian lands is being managed for livestock grazing without adequate consideration for antelope needs.

Turkey: The ponderosa pine-Gambel oak forest along the southern and western portion of the Basin provides good to excellent habitat for wild turkey. (See Distribution of Big Game Map - Turkey, following page 2-14). Turkey hunts are conducted in October when any turkey may be taken without a permit and in April when only bearded turkeys may be taken with a permit. Demand for both hunts has decreased slightly over the past 10 years, while turkey populations have remained static or have increased in many areas.

The goal of the Game and Fish Department is to maintain turkey numbers, meet demand for fall hunting, and maintain the quality of the spring hunt.

Objectives to be met by 1985 include: coordinate with land managers to produce measurable improvements in turkey habitat, maintain the existing hunter densities during spring hunt, and allow up to 9,000 hunters to hunt turkey in the Basin during the fall hunt before restricting use.

TABLE 2-5. Summary of Turkey Classification and Harvest Information, Units 1 Through 5 and 7 (Basin Area)

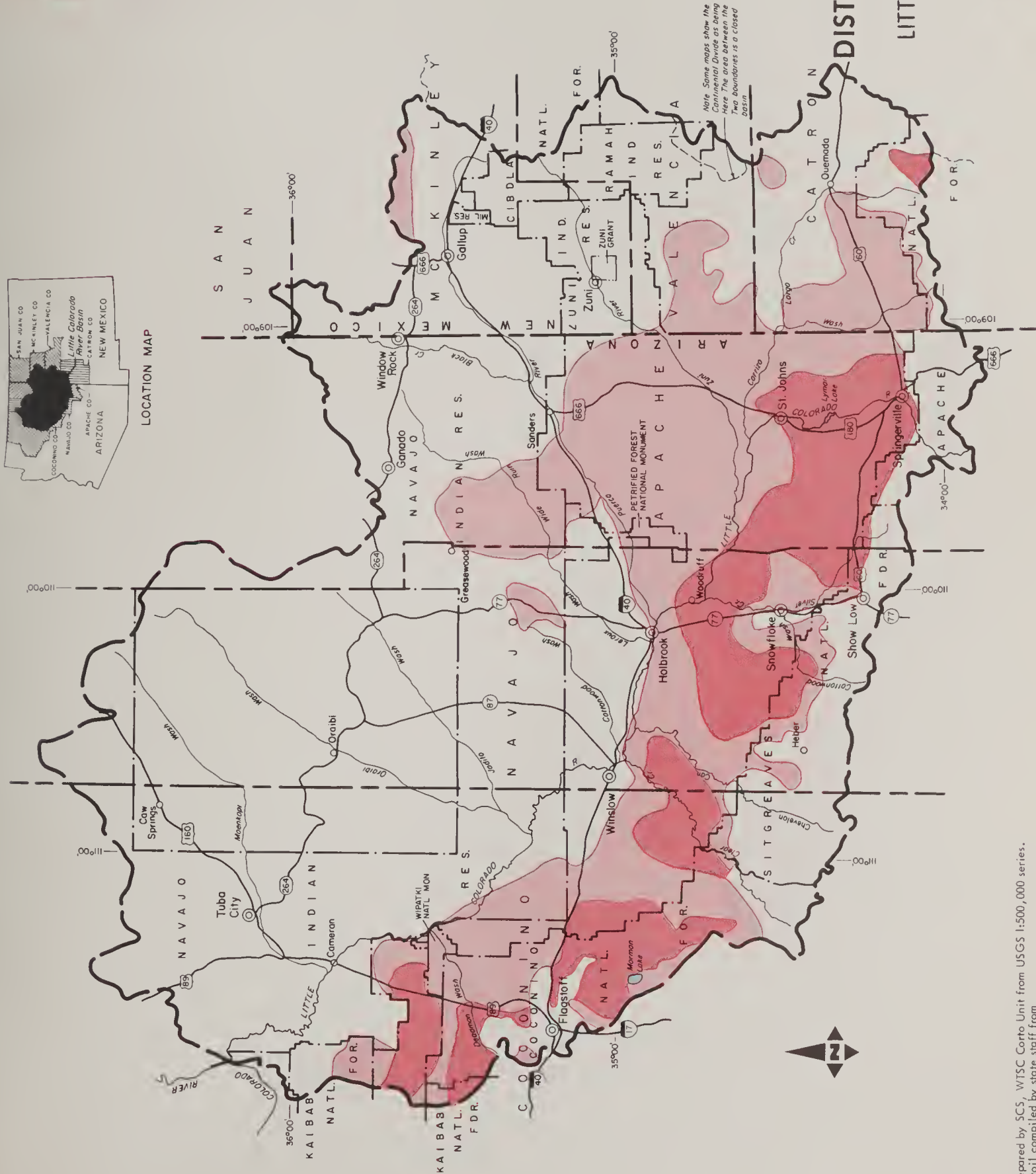
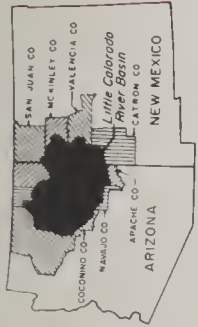
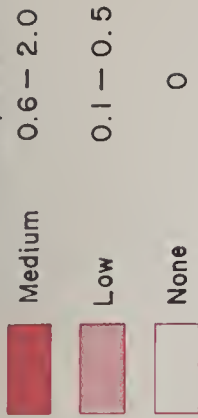
Year	Survey Counts	Poults/ Hen	Fall Hunt			Spring Hunt		
			Hunters	Harvest	Percent Success	Hunters	Harvest	Percent Success
1975	738	4.1	5,181	587	11			
1976	800	5.0	4,209	220	5	755	105	14
1977	872	4.5	4,927	366	7	1,227	157	13
1978						1,401	183	13

Problems in meeting goals and objectives for turkey management are:

1. Lack of coordination of timber, grazing, and recreation management practices with turkey management. Specific activities which have an adverse impact on turkeys, include:
 - Sawtimber harvest which eliminates or modifies roost sites.

LEGEND

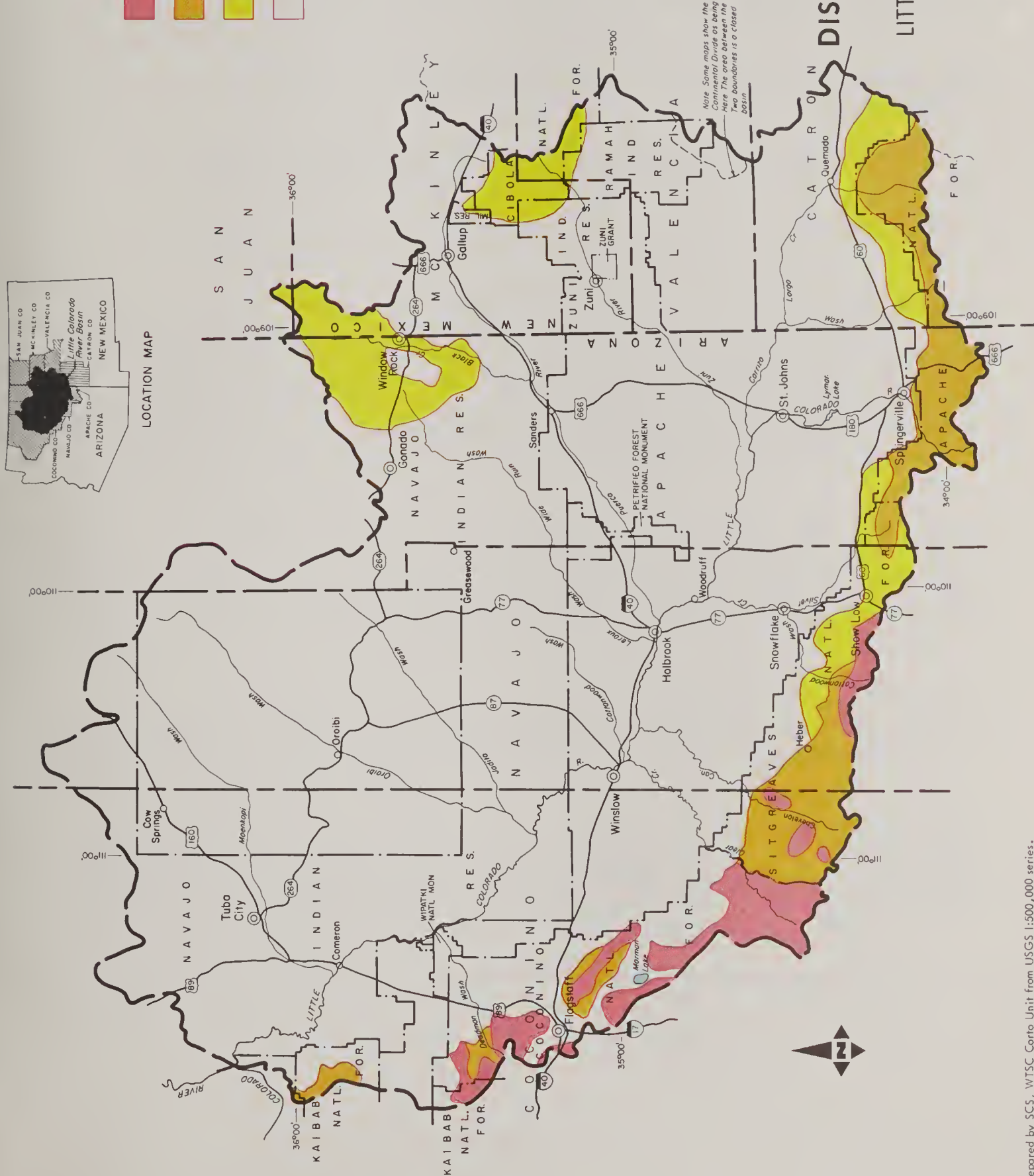
Estimated Number of Antelope Per Section



DISTRIBUTION OF BIG GAME ANTELOPE
LITTLE COLORADO RIVER BASIN
ARIZONA AND NEW MEXICO



Source: Base map prepared by SCS, WTSC Corto Unit from USGS 1:500,000 series. Thematic detail compiled by state staff from Arizona Game and Fish Department New Mexico Department of Game and Fish U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE



Source: Base map prepared by SCS, WTSC Corto Unit from USGS 1:500,000 series. Thematic detail compiled by state staff from Arizona Game and Fish Department New Mexico Department of Game and Fish Branch of Fish and Wildlife, Navajo Tribe U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

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- Sawtimber harvest which removes or modifies stringers of ponderosa pine extending into winter habitat.
 - Silvicultural practices which reduces oaks and junipers in the forest community.
 - Vegetation management which reduces tree and shrub cover adjacent to isolated water sites.
 - Livestock grazing which reduces forage cover for poult is believed to result in increased predation.
 - Human encroachment on turkey habitat is increasing with new road, recreation home, and camping developments.
2. Fuel management and fire suppression practices need studying to determine opportunities to benefit turkey habitat.
 3. Guidelines for determining hunting seasons and permit numbers are needed.

Bear: The Arizona Game and Fish Department's wildlife managers estimate the bear population in the Basin to be 600. It is believed the numbers have remained stable during recent years. The Department does not conduct formal bear census counts, but relies on general observations and reports from hunters and other agency personnel. Information on individual bears is occasionally obtained through trapping, tagging, and releasing nuisance bears. Bears harvested in the Basin have averaged 41 percent during the past 3 years.

Good bear habitat generally is associated with sparsely developed areas away from human activities. (See Distribution of Big Game Map - Bear, following page 2-16). However, a few bears are usually found near inhabited areas where they can scavenge refuse. Drought alters bears' feeding habitats and often causes them to seek man's refuse or become livestock killers.

Problems identified by the State include: alteration of riparian habitats, lack of information on bear populations along the Mogollon Rim, and illegal kills. Conflicts between bears and people are expected to increase at recreation sites.

Mountain Lion: Mountain lions occur in most of the undeveloped forest and woodland areas within the Basin. (See Distribution of Big Game Map - Mountain Lion, following page 2-16). Their habitat has been greatly reduced by man's developments in the forested areas. The Game and Fish Department is currently conducting research on the mountain lion.

Estimated lion numbers and annual harvest data is not available for the Basin.

Buffalo: The Arizona Game and Fish Department manages a herd of 120 buffalo on the Raymond Ranch southwest of Winslow. Each year a permitted hunt is held to harvest a designated number of animals. In 1977, the herd was reduced by 36 head through the hunt.

New Mexico Non-Indian Lands

The Basin is located within the New Mexico Department of Game and Fish Northwest Area, with offices at Albuquerque, and the Southwest Area, with offices at Las Cruces. The Valencia and Catron County line serves as the Area boundary. There are two game management units totally within and three partially within the New Mexico portion of the Basin (see Big Game Management Units Map following page 2-10). Wildlife managers conduct annual surveys to determine population trends, sex, and age classification, browse utilization, harvest data, and management information for use in making game harvest recommendations. The survey results are published in annual performance reports for each big game species.

The New Mexico Department of Game and Fish completed a comprehensive plan for wildlife management in 1978. Part 1, the Strategic Section, addresses philosophical bases of wildlife management, public affairs, law enforcement, and authorities. Goals, objectives, and strategies for all types of wildlife are listed. Part 2, Game Maps, shows distribution of deer, elk, antelope, and fish, population and habitat trends, and critical habitat areas.

The following discussion and tables provide information for the major game species in the New Mexico portion of the Basin. Distribution of each specie is shown on the respective Big Game Distribution Map(s) referenced in the Arizona Non-Indian Lands portion of this report.

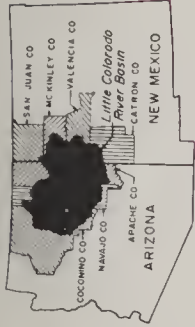
Mule Deer: The Basin area is nearly comparable in location to the Department of Game and Fish's Gallup Deer Herd Unit. (This includes hunting units nos. 10, 11, and 12).

TABLE 2-6. Summary of Mule Deer Classification and Harvest Information for Gallup Deer Unit

<u>Year</u>	<u>Deer Observed During Survey</u>	<u>Fawns/ 100 Does</u>	<u>Number Hunters</u>	<u>Harvest</u>	<u>Percent Hunters Success</u>	<u>Days/ Harvest</u>
1975	209	15	4,808	513	11	27
1976	215	14	6,903	798	12	22
1977	155	10	3,955	313	8	30

Population trends are considered stable and habitat conditions are generally poor with a stable trend. The fawn survival rate is extremely low, 70 percent below the State average.

Activities adversely affecting deer management include: poaching, human encroachment and developments, and excessive livestock grazing. Oil, gas, and mineral exploration in the Fence Lake-Quemado areas also create a disturbance to deer and antelope.



LOCATION MAP

LEGEND



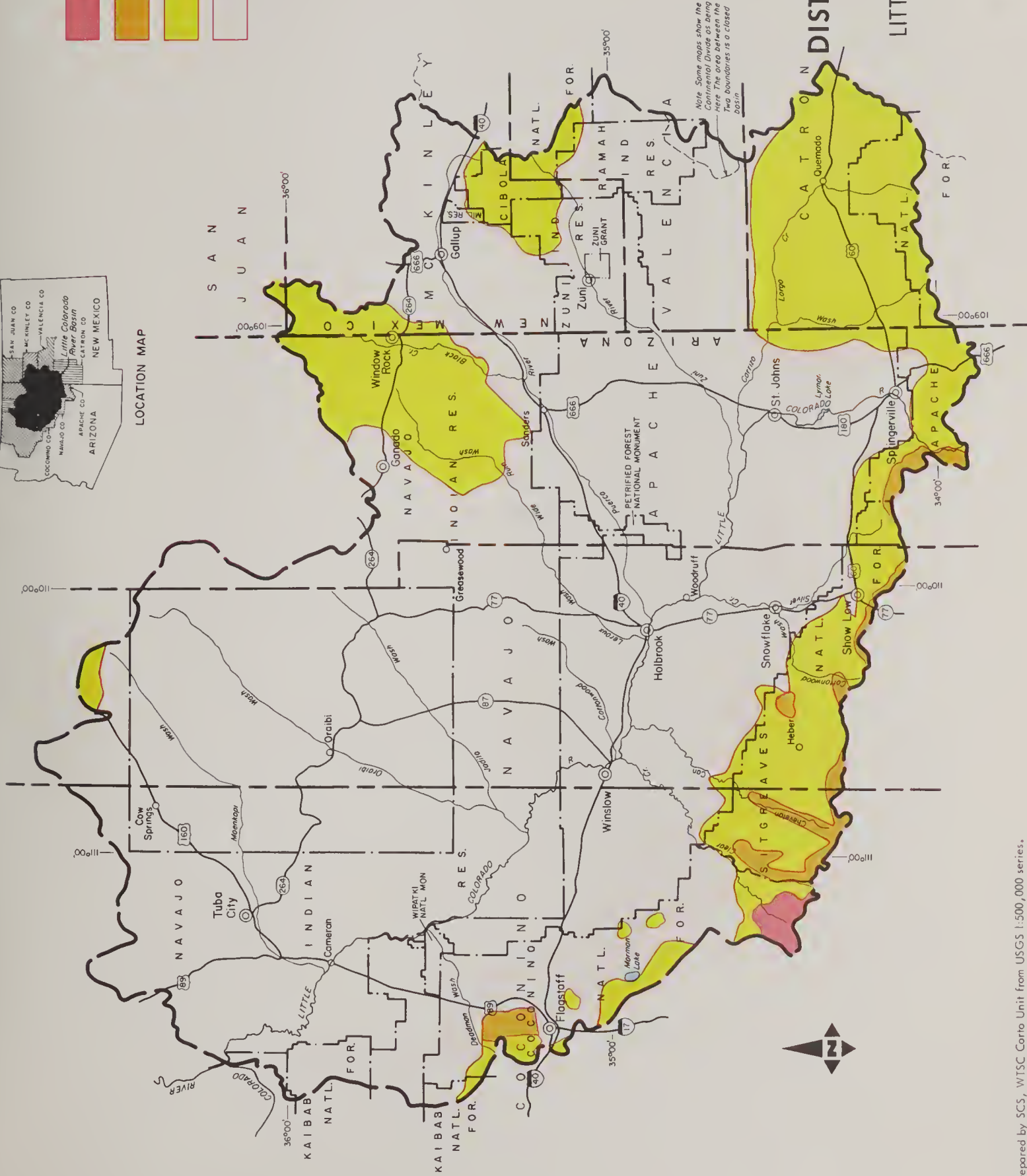
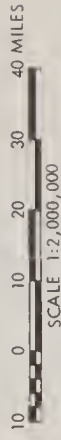
* Estimated Number of Bear per Section



DISTRIBUTION OF BIG GAME BEAR

LITTLE COLORADO RIVER BASIN ARIZONA AND NEW MEXICO

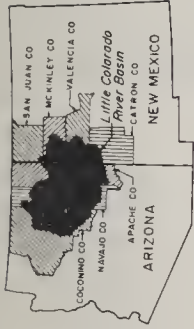
JANUARY 1980



Source: Base map prepared by SCS, WTSC Corro Unit from USGS 1:500,000 series. Thematic detail compiled by state staff from Arizona Game and Fish Department, New Mexico Department of Game and Fish, Branch of Fish and Wildlife, Navajo Tribe, U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

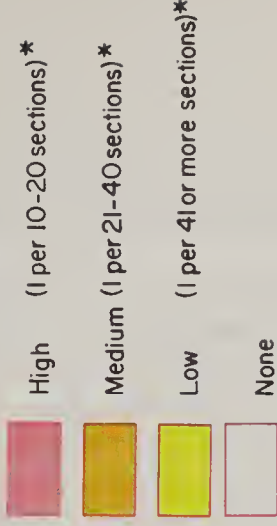
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LOCATION MAP

LEGEND



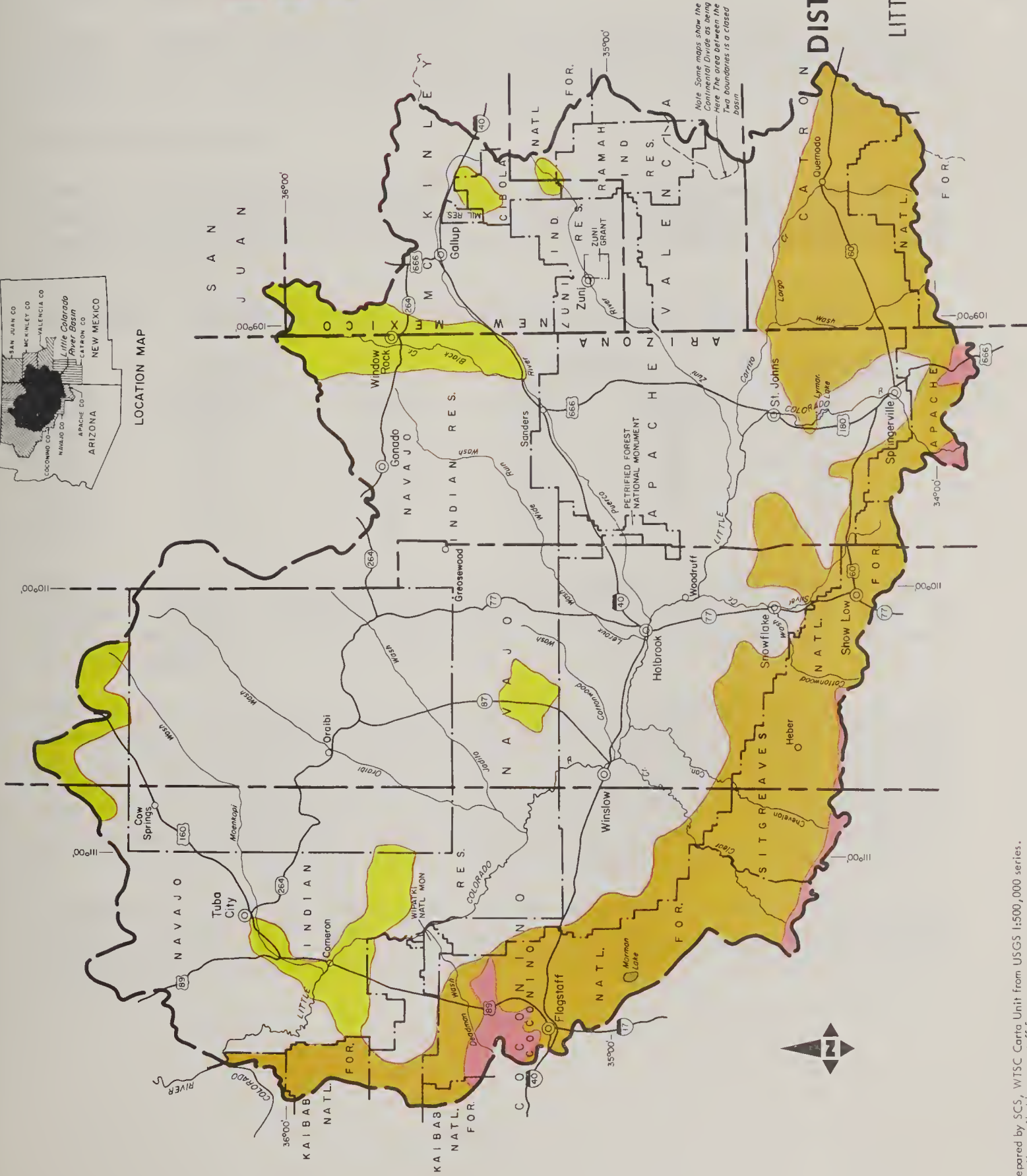
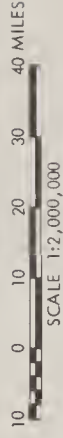
* Estimated number of lions



DISTRIBUTION OF BIG GAME MOUNTAIN LION

LITTLE COLORADO RIVER BASIN
ARIZONA AND NEW MEXICO

JANUARY 1980



Source: Base map prepared by SCS, WTSC Carta Unit from USGS 1:500,000 series. Thematic detail compiled by state staff from Arizona Game and Fish Department, New Mexico Department of Game and Fish, Branch of Fish and Wildlife, Navajo Tribe, U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

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Elk: A small number of elk occur in the Gallo Mountains south of Quemado. This is within the Luna Elk Herd Unit.

Antelope: The Red Hills antelope herds inhabit the areas west and north-west of Quemado. Department of Game and Fish surveys show antelope numbers to be about 140 with an upward trend. Fawn to doe ratios were 64/100 in 1975 and 11/100 in 1977. Coyote predation is believed to be one cause of fluctuating fawn crops. The state line fence and Highway 60 right-of-way fence restrict movement of antelope. The first hunt in many years of this herd was held in 1977.

Turkey: Merriam turkey occur in the Zuni Mountains and the Gallo Mountains. Both areas are open to hunting during fall and spring turkey hunts.

Navajo Reservation

There are portions of three Navajo big game management units in the Basin. The Navajo Fish and Wildlife Branch conducts game habitat and population surveys as a basis for the Tribal Council issuing annual hunting permits.

TABLE 2-7. Survey Information for Mule Deer, Navajo Units 4 and 5

<u>Year</u>	<u>Fawns/ 100 Does</u>	<u>Total Hunters</u>	<u>Harvest</u>		<u>Percent Success</u>	
			<u>Rifle</u>	<u>Archery</u>	<u>Rifle</u>	<u>Archery</u>
1973	20	212	105	16	70	25
1974	30	469	219	28	56	35
1975	57	328	161	17	66	20
1976	44	432	216	24	64	25
1977	45	550	168	15	36	17
1978	35					

Navajo big game hunts include: combination rifle and archery deer, general turkey, and spring gobbler. The rifle deer hunt is open to tribal members only. The other hunts are open to both Navajo and non-Navajo hunters.

The biggest problem in managing big game and waterfowl habitat on the Reservation is excessive livestock grazing. Sheep and deer prefer many of the same forage and browse plants. The Fish and Wildlife staff works closely with the Land Operation, Grazing and Forestry staffs, and with the Resources Committee of the Navajo Tribal Council. The objective is to reduce the impact of grazing and other activities on wildlife habitat and to increase numbers of deer, turkey, antelope, and waterfowl.

Illegal kills out of season and outside of permitted areas are also big factors in the low deer populations. Many Navajo have traditionally killed deer from their grazing lands without regard to hunting season or permits.

Predation by coyotes is believed to be a cause of low fawn to doe ratios.

Hopi Reservation

No big game hunting is permitted on the Hopi Reservation.

Zuni Reservation

Mule deer are the only big game species which are legally hunted on the Zuni Reservation. There are two hunts in November for tribal members with 400 permits and a December hunt for non-Zunis with 20 permits.

The primary problems in maintaining the deer herds on the Zuni Reservation is poaching and coyote predation. The Tribe is beginning to get improved deer habitat conditions through their livestock management and range improvement programs.

There are a few turkeys in pine forests and a few antelope in the southwest portion of the Reservation, but numbers are insufficient for issuance of hunting permits.

In the early 70's, the Zuni Tribe initiated a waterfowl habitat improvement project at Nutria Lake No. 3. An area was fenced to exclude livestock, pot holes were constructed, and waterfowl foods were seeded. The project has since been discontinued.

The Zuni Tribal Game and Fish Department has begun a 3-year management study program in conjunction with the proposed Yellowhouse Dam study. The study will evaluate the impact of the dam on game fish and opportunities for improving wildlife habitat and hunting.

MANAGEMENT AND HARVESTING OF SMALL GAME

The following small game, furbearers, and predators inhabit portions of the Little Colorado River Basin: cottontail rabbit, Abert's squirrel, raccoon, badger, coyote, skunk, weasel, bobcat, and fox. Both States allow hunting of these animals. Information as to the number of hunters and harvest is available for statewide but not available for the Basin.

Hunting for most of the above species is available for Indians on the Navajo and Zuni Reservations.

MANAGEMENT AND HARVESTING OF GAME BIRDS

Mourning doves, Gambel quail, scaled quail, Mearns quail, and grouse occur and are hunted within the Basin. Information on the number of hunters and harvest is not available for the Basin.

MANAGEMENT AND HARVESTING OF WATERFOWL

Waterfowl habitat within the Basin is limited and considerably below the potential. This is largely due to lack of vegetative cover adjacent to

streams, impoundments, lakes, and natural wetlands. Fluctuating water levels and livestock grazing are the conditions which are most responsible for low quality waterfowl habitat.

Waters which occur in the mountains, grasslands, and meadows have potential to provide excellent nesting sites and food sources for resident duck and geese populations. These waterfowl summer in the high country above the Mogollon Rim and winter in southern Arizona and New Mexico. Although the Basin does not have many large bodies of waters, a few, such as Mormon Lake, Lake Mary, Cholla Lake, and Lyman Reservoir, are used in the spring and fall by migratory waterfowl.

The public demand for waterfowl hunting is increasing with the rapid population growth in the Southwest. Many hunting waters are already overcrowded. In addition, there is an increasing demand for non-consumptive recreation provided by wetlands, such as bird watching, nature and wildlife photography, and environmental studies.

The U.S. Fish and Wildlife Service conducts surveys, provides technical assistance for habitat management, and establishes hunting regulations for migratory waterfowl. Land management agencies, private landowners, and Indian tribes have responsibilities for managing and improving habitat.

FISHERIES MANAGEMENT

There are 70 miles of streams and 6,363 surface acres of ponds, reservoirs, and lakes currently suitable for fishing. A list of Basin fisheries is shown in Table 2-8, pages 2-20 and 2-21. The majority of these are cold water fisheries (see Fishing Lakes and Streams Map, following page 2-22). Due to seasonal variances in stream flows, stream fishing provides much less recreation than the total miles of streams in the Basin would indicate. Both streams and lakes are managed on an annual "put and take" basis for trout.

Public Fisheries

Public fisheries are stocked and the fishing is managed by the respective State Game and Fish Departments. Both States have constructed fishing impoundments in the Basin. These usually have adequate water supplies. Irrigation impoundments also provide fishing opportunities, but due to seasonal drawdown of water, it is difficult to maintain good fish habitat and fishing conditions.

Many of the streams and impoundments on Federal lands are being monitored by agency biologists for water quality and opportunities for fishery improvement work.

The number of angler days and number of fish taken is unavailable for the Arizona portion of the Basin. The 1977 Arizona State Comprehensive Outdoor Recreation Plan shows 866,100 fishing occasions in Apache, Navajo, and Coconino Counties. An estimated 600,000 of these occurred within the Little Colorado River Basin.

TABLE 2-8 Fisheries in the Little Colorado River Basin

<u>Arizona</u>		
<u>Name</u>	<u>Average Surface Acres of Lakes</u>	<u>Type Fish</u>
Antelope Lake*	3	T
Ashurst Lake	230	T
Bear Canyon Lake	63	T
Becker Lake	96	T
Black Canyon Lake	78	T
Blue Ridge Reservoir	70	T
Bunch Reservoir	20	T
Chevelon Canyon Lake	200	T
Cholla Lake	360	W
Clear Creek Reservoir	20	TW
Coconino Reservoir	30	T
Concho Lake	155	T
Fools Hollow Lake	149	TW
Ganado Lake*	360	W
Hidden Lake* <u>1/</u>	5	T
Hulsey Lake	5	T
Keams Pond***	4	TW
Kinnikinick Lake	145	T
Knoll Lake	75	T
Lee Valley Lake	35	T
Little Mormon Lake	70	W
Lyman Reservoir	600	W
Long Lake	270	TW
Lake Mary (Lower)	100	TW
Lake Mary (Upper)	600	TW
Mormon Lake	600	W
Nelson Reservoir	100	T
Rainbow Lake	100	TW
River Reservoir	75	T
Scott's Reservoir	40	TW
Show Low Lake	100	TW
Soldiers Lake	15	W
Soldiers Annex Lake	60	W
White Mountain Lake	283	TW
Willow Springs Lake	90	T
Woods Canyon Lake	50	T
Woodland Reservoir	10	TW
	<u>5,266</u>	

1/ Dam was partially breached in 1977.

TABLE 2-8 (con't). Fisheries in the Little Colorado River Basin

Arizona

<u>Name</u>	<u>Type Fish</u>	<u>Miles Stream</u>
Chevelon Creek	T	10
Clear Creek (east)	T	24
Clear Creek (west)	TW	1
Little Colorado River	T	21
Mineral Creek	T	1
Silver Creek	TW	<u>13</u>
		70

Surface Acres of Lakes

<u>New Mexico</u>	<u>MAX.</u>	<u>NORM</u>	
Assayi*	36	23	T
Black Rock Lake**	436	100	W
Eustace**	10	10	W
Galesteno Number 1**	10	6	T
Galesteno Number 3**	12	12	T
Mariano Lake*	20	20	T
McGaffey Lake	14	14	T
Nutria Lake Number 4**	88	80	T
Ojo Caliente Lake**	130	40	TW
Pescado Lake**	120	50	TW
Quemado Lake	136	130	T
Ramah Agency Ponds*	12	12	TW
Red Lake*	908	600	TW
	<u>1,932</u>	<u>1,097</u>	

T = Trout Species

W = Warm Water Species

* = Fisheries requiring permit from Navajo Tribe

** = Fisheries requiring permit from Zuni Tribe

*** = Fisheries requiring permit from Hopi Tribe

Sources of fishery information

- Publications - Arizona Fishing Holes
- New Mexico Fishing Water
- Fishing in Navajo Land
- Fishing in Zuni
- New Mexico State Engineer's office

TABLE 2-9. Fishing Use at Public Lakes in New Mexico Basin Area

<u>Water</u>	<u>Angler Days</u>	<u>No. Fish Harvest</u>
McGaffey Lake	2,067	4,063
Quemado Lake	23,514	66,296

Source: The 1976 New Mexico Performance Report for Fisheries.

Indian Reservation Fisheries

The Navajo, Zuni, and Hopi Tribes manage their fisheries with assistance from U.S. Fish and Wildlife Service biologists. Tribal permits are required for both Indians and non-Indians for fishing Reservation waters.

Most of the impoundments on the three Reservations were built solely for irrigation or for watering livestock, so it is not surprising that they are difficult to manage as fisheries. Many are large, shallow structures that lose enormous quantities of water each year to evaporation. Annual precipitation in the area is subject to wide variation, so that a lake may fill completely one year and receive no runoff whatsoever the next. Also, irrigators often waste large amounts of stored water due to inefficient delivery systems and the use of more water than is necessary to grow crops.

A complete list of Indian Reservation fisheries along with a discussion of each may be found in the Supplementary Data attached to this section of the report.

TABLE 2-10. Fishing Use on Indian Lands and Fort Wingate, 1977

	<u>Estimated Angler Days</u>	<u>Estimated No. of Fish Harvested</u>
Navajo Indian Reservation (within Little Colorado River Basin)	8,000	32,000
Zuni Indian Reservation	10,000	40,000
Hopi Indian Reservation	1,500	4,000
Fort Wingate Depot Activity	500	1,200

Source: U.S. Fish and Wildlife Service, Gallup, New Mexico.

The Tribes provide a valuable public service by making available recreational fishing opportunities in an area where such opportunities are definitely limited.

Private Fisheries

There are approximately four small private lakes and ponds in the Basin where fishing is available on a fee basis. These enterprises purchase fish from hatcheries, feed them to maximize growth, and charge customer's based on the pounds of fish caught.

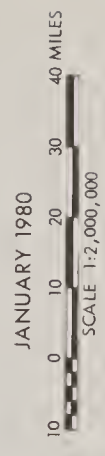


LEGEND

- Cold Water Public Fisheries
- Warm Water Public Fisheries
- Stream Fisheries
- Private Fisheries
- ▲ Indian Reservation Fisheries

**FISHING LAKES AND
STREAMS**

**LITTLE COLORADO RIVER BASIN
ARIZONA AND NEW MEXICO**



Source:
Base map prepared by SCS, WTSC Carto Unit from USGS 1:500,000 series.
Thematic detail compiled by state staff from
Arizona Game and Fish Department
New Mexico Department of Game and Fish
Branch of Fish and Wildlife, Navajo Tribe
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

USDA SCS-PORTLAND OR 1980

M7-OL-24030-14

Fishery Management Problems

In extreme cases, fluctuating water levels result in total loss of fish populations during periods of drought.

Submerged aquatic vegetation frequently is a problem with shallow, clear lakes. As long as a lake has a sufficient amount of deep water, submerged aquatic vegetation will not become abundant enough to be harmful. Excessive amounts of submerged aquatic vegetation cause summerkills by raising pH to lethal levels and winterkills by depletion of oxygen.

Sediment often smothers bottom organisms and organic bottom soils and shortens the life span of lakes. Much of the sedimentation problem is due to poor upstream watershed conditions. To decrease sediment deposition, a number of lakes have been located offstream and are filled by diverting water from intermittent watercourses. However, this measure has been only partly successful due, among other things, to deficiencies in the operation and maintenance of the diversion structures.

Turbidity, which drastically lowers productivity, is often a problem of shallow lakes, where wind action keeps the bottom stirred up. However, there are many other shallow lakes that are seldom turbid, because turbidity is related to certain watershed conditions, soil types, and water chemistry.

Trash fish, such as green sunfish and black bullheads, frequently cause serious problems when they become established in trout lakes. In the absence of predators to keep their numbers in check, they reproduce rapidly and soon overpopulate the lake. The trout cannot successfully compete with them and so trout fishing deteriorates drastically. The only way to restore the trout fishery is to completely eradicate the trash fish and then start all over again with trout.

Excessive removal of vegetation from along streams results in increased water temperatures and streambank erosion.

Opportunities for Improving Recreational Fisheries

1. Proper watershed management and proper operation and maintenance of diversion structures to minimize siltation of lakes.
2. Regulation of the use of irrigation water and improvement of irrigation distribution systems to minimize waste of stored water.
3. Construction of additional fishing lakes as long as such lakes incorporate proper design criteria for fish conservation, such as adequate depth, protection from siltation, etc.
4. Deepening of shallow lakes by increasing the height of the dam, relocation of the dam, excavation of the bottom, or other feasible means.

5. Eradication of trash fish from all lakes that are suitable for trout management.
6. Improve grazing and timber harvest techniques within streamside zones to maintain desirable vegetation cover for good fish habitat.

Fishing Demand

The demand for fishing in the Basin is estimated to increase by above 3 percent per year from 1980 to 2020.

ECONOMIC VALUES

The Arizona Game and Fish Department conducted a survey of hunting and fishing within the State covering the year 1970. The general objective was to determine the total economic value of benefits assignable to fish and wildlife in Arizona. The results were published in Research Report 270, entitled, Participation and Expenditures for Hunting, Fishing, and General Rural Outdoor Recreation in Arizona, Agricultural Experiment Station, University of Arizona, August 1973.

The categories of variable expenses included in the study were: lodging, additional food and refreshments, transportation, and other items. Fixed costs, such as camping equipment, vehicle depreciations, firearms, and other equipment, which would be used on more than one trip, were excluded. Hunting and fishing expenditures in terms of 1970 dollars, as reported in the study, are shown in Table 2-11.

TABLE 2-11. AVERAGE COSTS PER HOUSEHOLD-TRIP, PER HOUSEHOLD-DAY
AND PER HUNTER DAY^a

Types of Hunting or Fishing	Per Household Trip	Per Household Day	Per Angler or Hunter Day
Fishing			
Cold Water	\$24.94	\$13.04	\$4.97
Warm Water	14.36	9.24	3.96
Hunting			
Big Game	24.02	12.72	8.47
Small Game	9.80	9.05	5.92
Waterfowl	12.03	10.77	7.65
General	<u>9.68</u>	<u>8.18</u>	<u>6.74</u>
WEIGHTED AVERAGE	\$16.68	\$10.65	b

^a Residents and non-residents.

^b Not applicable.

Table 2-12 shows expenditures in the Little Colorado River Basin based on reported and estimated hunting and fishing use and the Statewide average expenditures.

TABLE 2-12. Expenditures for Hunting and Fishing in the Little Colorado River Basin.

ARIZONA - 1977

<u>Type of Fish or Game</u>	<u>Angler and Hunter Days</u>	<u>Daily Expenditure</u>	<u>Total Expenditure</u>
All Fish	600,000	\$4.80	\$2,880,000
Deer	26,400	8.47	223,600
Elk	18,000	8.47	152,500
Antelope	680	8.47	5,800
Turkey	15,600	8.47	132,100
Bear & Lion	400	8.47	3,400
Quail & Dove	5,000	5.92	29,600
Rabbits & Squirrel	15,000	5.92	88,800
Waterfowl	15,000	7.65	114,700
			<u>\$3,630,500</u>

NEW MEXICO - 1977

All Fish	25,600	\$4.80	\$ 122,900
Deer	14,400	8.47	122,000
Antelope	80	8.47	700
Turkey	400	8.47	3,400
Bear & Lion	100	8.47	800
Quail & Dove	500	5.92	3,000
Rabbit & Squirrel	800	5.92	4,700
Waterfowl	1,000	7.65	7,600
			<u>\$ 265,100</u>

Basin Total (in terms of 1970 dollars) \$3,895,600.

OPPORTUNITIES

HABITAT MANAGEMENT AND IMPROVEMENT

The Arizona and New Mexico State Game and Fish Departments have prepared strategic management plans for all game species. The Forest Service, Bureau of Land Management, and Indian tribes each have developed wildlife habitat plans for their respective lands. The Soil Conservation Service and Fish and Wildlife Service have technical guides which they apply when assisting private landowners and Indian tribes.

The two activities which have contributed the greatest to the degradation of wildlife habitat in the Little Colorado River Basin are: developments and associated human activities, i.e., roads, housing, and recreation facilities, and domestic livestock grazing. Many of the problems previously discussed in this report are a result of livestock grazing. In some cases, livestock and wildlife compete for the same forage and in other cases livestock grazing reduces the vegetation cover required for the protection of young animals and birds. It should be noted that certain practices relating to livestock grazing are beneficial to some wildlife species, i.e., water developments and rangeland seeding.

Following are but a few of the many opportunities for managing and improving wildlife habitat. Recommendations are based on two considerations: First, if the habitat is to be managed strictly for wildlife. Second, if both livestock use and wildlife use are to be considered.

Spruce Alpine Fir Forest

a. Habitat management for wildlife.

1. Openings should be made in closed, continuous stands of timber. Openings should be no wider than 300 yards. Approximately 1/5 of a closed forest should be open. Clearcut openings will remain productive for 15 to 20 years. This system can be achieved on a 120-year rotation, 20-year cutting cycle.
2. Optimum size and shape of openings is not known. Approximately 10 to 20 acre/openings, 4 to 5 per section, should be planned unless local research indicates otherwise.
3. Retain all natural openings in the forest by cutting invading trees.
4. Leave some slash where it falls for soil protection and cover forbs and shrubs released from the shading effects of trees.
5. Limit sheep allotments on elk summer range. Elk appear to have a low tolerance for sheep.

b. Habitat management for livestock and wildlife.

1. Practice proper grazing use, especially on the wetlands, meadows, and other open areas in the forest.
2. Include some forbs and non-bloat legumes in seeding mixtures on logging roads and for open area seedings.
3. Keep spruce cut back to preserve openings in the forest.

Montane Conifer Forest

a. Habitat management for wildlife.

1. Thin aspen groves to approximately 75 percent of basal area of mature stands. Fence aspen stands to exclude livestock. Leave aspen along streams for beaver.
2. Thin or selectively harvest timber to maintain a basal area of 80 to 100 sq. ft. per acre on a cutting cycle of 10 to 15 years.
3. Pine invasion into open meadows should be controlled to prevent closure of the meadows. Livestock must be closely controlled to prevent overuse.

4. Seed adapted forbs and browse where needed to improve wildlife forage and cover conditions.
- b. Habitat management for livestock and wildlife.
1. Retain all open areas; leave selected snags.
 2. Add forb and browse seed to seeding mixtures to be planted for livestock forage.
 3. Create openings in continuous timber stands.
 4. Proper grazing use and a grazing system which incorporates periods of rest is essential.

Juniper-Pinyon Woodland

Any habitat manipulation in this vegetative type should be approached with caution. Plan succession on cleared areas is difficult to predict. The release of an undesirable plant from the understory after tree removal could well be an exchange of one undesirable species for an equally or more undesirable one.

Competition between livestock and wildlife can be severe. One of the best ways to reduce competition on native browse is to satisfy livestock need by habitat manipulation on the very best lands. A good grazing system is essential.

- a. Habitat management for wildlife.
1. Clear no more than 50 percent of continuous stands and in blocks no wider than 1/8 mile.
 2. Clear in blocks rather than strips.
 3. Leave at least 25 mature trees per acre in the cleared blocks.
 4. Provide one or two 10 to 20 fenced plantings per section. Seed to adapted grasses, legumes, and forbs which will reproduce green feed in late winter and early spring.
 5. Leave a minimum of 1/8 mile of undisturbed cover between cleared strips or blocks.
 6. Develop water to a minimum of one facility per four sections. Locate each facility in the center of the block of four sections.
 7. Retain at least 5 percent of the area in young juniper, if present.

b. Habitat management for livestock and wildlife.

1. In brush clearing, retain vegetation on approximately 15 percent of the total area to be cleared, and on all slopes steeper than 15 percent.
2. In brush clearing, retain all vegetation at least 100 feet on both sides of all major streams, arroyos, gullies, etc., for escape, cover, and travel routes.
3. Do not clear rocky points or ridge tops.
4. Uncleared areas should be approximately 15 percent of the total area of the unit being considered.
5. Areas of pinyon known to be especially good nut producers should be left undisturbed.
6. Include grasses, forbs, and legumes beneficial to wildlife in seeding mixtures to be used on disturbed areas.
7. Install a grazing system which incorporates periods of rest.

Plains and Desert Grassland

a. Habitat management for wildlife.

1. Protect existing stand of grass from livestock three of each 4 years.
2. Burn 20 to 40-acre patches in pure grass stands and seed to forbs and legumes.
3. Develop water facilities, one in the middle of each four sections.

b. Habitat management for livestock and wildlife.

1. Practice proper grazing use and use some kind of planned grazing system.
2. Where snakeweed or similar woody species is treated or controlled, add forbs to the reseeding mixtures.

Mountain Meadow Grassland

a. Habitat management for wildlife.

1. Plow and seed one-half of each meadow for adapted forbs and legumes. Fence to protect from livestock.
2. Where unpalatable weeds or grasses are a problem, plow or disc and reseed to grasses and forbs.

- b. Habitat management for livestock and wildlife.
 - 1. Include forbs and legumes in all reseeding mixtures.
 - 2. Inventory mountain meadows which are being used by elk. Determine the elk forage requirements and where needed adjust elk and/or livestock use to where it is commensurate with forage production.
 - 3. Insure that proper grazing use is practiced. High priority should be given to the preservation and improvement of riparian vegetation.

Great Basin Desert Scrub

Many of these sagebrush-shadscale areas are extremely important to wintering wildlife. Consultation with appropriate Federal and State land managers and the State Game and Fish Departments is absolutely essential. This will prevent inadvertent destruction of a key wintering area.

- a. Habitat management for wildlife.
 - 1. Clear 40 acres-per section patches in homogeneous brush stands. Seed to forbs, legumes, and grasses. Seed at twice the rate normally recommended.
 - 2. Fence key wintering areas to exclude livestock.
 - 3. Develop watering facilities, one or two per section, for all wildlife.
- b. Habitat management for livestock and wildlife.
 - 1. In any clearing job, leave brush on all rocky areas, steep slopes, along canyon walls, arroyos, and washes. Leave 50 to 150 feet of vegetation along each side of all major drainage ways.
 - 2. Do clearing and seeding on the best land in the unit. This should be done on a small scale in each sub-area until impacts on livestock and wildlife can be determined.

Riparian and Wetland Habitat

Riparian and wetland habitats in semiarid environments are unique reservoirs of plant and animal diversity. The influence of these habitats on wildlife is not limited to those animal species that are restricted in distribution to the streamside and wetland vegetation. Studies demonstrate that the population densities of wildlife in habitats adjacent to the riparian and wetlands are influenced by the presence of these vegetation types.

a. Habitat management for wildlife.

1. Livestock grazing must be managed so as to maintain adequate vegetative cover and water quality to meet the requirements of the wildlife, birds, and fish which inhabit these areas. In some cases this will require total livestock exclusion; in other cases deferred and/or alternate seasonal grazing would be compatible with wildlife needs.
2. Human activities must be managed so as to prevent disturbance of waterfowl nesting.
3. Management of stream flows and reservoir water levels must meet the requirements of fisheries and waterfowl when applicable.

All Habitat Types

Prime wildlife habitat should be managed to enhance wildlife populations by limiting developments and conflicts from other uses. Public awareness of actual and potential loss of prime wildlife habitat should be provided through news media, public schools, and individual contacts. Some management practices are:

- a. Develop plans to utilize prescribed fire and natural occurring fire for habitat improvement (19).
- b. Maintain existing water developments and develop new facilities for wildlife where other water is not available.
- c. Acquisition of habitat, particularly areas critical or significant to the viability of wildlife populations, by State and Federal agencies and private organizations for the retention of the area as wildlife habitat.
- d. Island construction to create a high water-land ratio edge to satisfy territorial occupancy which is important to waterfowl.
- e. Seeding of islands and shorelines to improve cover and feeding areas primarily for waterfowl.
- f. Utilize the information gained through experience, field research, and literature review to formulate guidelines for coordinating land management practices with individual wildlife habitat requirements. This coordination will benefit those species within their respective habitats.

Examples of where improved coordination in the management of other resources will enhance wildlife habitat include:

Timber Management: In planning timber harvest, locate and delineate for preservation two turkey roost sites per square mile.

Locate and delineate for preservation ponderosa pine stringers which serve as corridors for turkey travel between the forest and woodland habitat types.

Keep logging trash from all streams. Leave all streamside vegetation, trees, etc., during logging operations.

Gambel oak, silver-leaf oak, and other shrubs should be managed to maintain a balance between mast and browse, and herbaceous foliage.

Within turkey habitats, silvicultural practices should provide for a diversity of tree species, i.e., pine, oak, juniper, and riparian.

In planning timber sales, provisions should be made to preserve cover for turkeys to travel to isolated watering sites.

In planning timber sales, identify and protect nest trees and preferred feed trees for tree squirrels.

Maintain, through management, snags in sufficient quantity, quality, and distribution to support self-sustaining populations of cavity-nesting birds.

Range Management: When conducting type conversion projects, such as trees and brush to grass, use methods that are known to enhance the habitat of big game and other wildlife which occur in the project area.

On Federal lands and State trust lands where excessive grazing is a limiting factor in maintaining desirable wildlife populations, the State Game and Fish Department and the land management agency should coordinate efforts in gaining support from livestock operators and the public to achieve moderate grazing.

Develop and implement fencing standards that serve the livestock industry's needs and permit big game animals free movement.

Livestock which graze in areas inhabited by elk should be managed in a manner which has minimum impact on elk. Elk are socially intolerant of cattle and sheep.

When developing livestock water, provide a means for wildlife to utilize water.

Mineral Management: Where exploration and development of minerals occur within critical wildlife habitats, these operations should be scheduled for a time of the year when they would have the least impact on wildlife.

Transportation Systems: The State Game and Fish Departments should continue to review and comment on all proposed roads, both public and private. Where possible, location and use should be planned so as to minimize adverse effects on wildlife populations.

When roads are no longer needed, they should be closed, such as roads for mineral exploration, logging, and seasonal recreation use.

Recreation Management: Prior to installing recreation developments, including trails, carefully assess the potential impacts which the human intrusion will have on wildlife. This is vitally important in areas of limited habitat such as riparian zones and meadows.

The primary responsibility for coordination, formulating guidelines, and implementing appropriate action lies with the private landowner, the State land departments, the Forest Service, the Bureau of Land Management, the National Park Service, and Tribal Councils.

Others with generally secondary responsibilities, but equal importance in formulating guidelines and providing technical assistance, are the State Game and Fish Departments, State Forestry departments, the Soil Conservation Service, the U.S. Fish and Wildlife Service, and the Bureau of Indian Affairs.

Others with responsibilities for implementing certain actions include: the grazing permittee and lessee of Federal and State rangelands, individuals grazing on Indian lands, the timber sale contractor, and mineral lessee contractors.

The private sector has a responsibility to monitor and comment on current and proposed actions affecting wildlife habitat.

POPULATION MANAGEMENT AND REGULATIONS

The following is a partial list of the needs and opportunities from the Arizona and New Mexico wildlife strategic plans.

- Manage wildlife populations for their benefit and for consumptive and nonconsumptive uses; management procedures will include introduction, propagation, transplantation, and removal of wildlife and regulation of hunting and fishing seasons and consumptive use.
- Identify areas important or critical to the viability of particular species. Provide preferential management to those species, as necessary to promote the viability of wildlife populations or enhance consumptive and nonconsumptive uses.
- Provide information collected for use in public affairs programs to heighten awareness of wildlife values and needs.
- Solicit public opinion on wildlife issues and utilize public input to make management recommendations.
- Foster State and Federal legislation to guarantee recognition of wildlife needs as a legitimate and beneficial use of water and land resources.

- Pursue cooperative programs with Federal land management agencies for wildlife enhancement.
- Conduct surveys, compile information, and obtain legal authority necessary for management of nongame wildlife as a viable and integral part of the ecosystem.
- Study records and conduct surveys to determine past and present numbers, distribution, habitat usage, and natural history of existing and potentially endangered wildlife species.
- Establish criteria for setting hunting seasons and for determining harvestable surplus of game species.
- Assess the benefits and weaknesses of the permit systems and stratified hunts to obtain maximum hunter distribution and optimum harvest.
- Improve methods for determining numbers of illegally killed game and determine what effects the illegal kills have on the overall population management.

RESEARCH

Wildlife managers are faced with many unanswered questions when addressing habitat and population management problems. These can best be met through research and special studies.

Some research needs within the Little Colorado River Basin are:

- Determine the relationships between fawn survival of mule deer and antelope and coyote densities on grazed and ungrazed grassland ranges.
- Determine the relationship between mule deer fawns, antelope fawns, and turkey poults with the quality and quantity of each species' preferred forage on grazed and ungrazed livestock ranges; i.e., what effect does different intensities of livestock grazing have on survival of young wildlife populations?
- Measure the effects of predation on turkey flocks and its relationship to available vegetative cover.
- Determine the interrelationship between antelope and cattle who occupy the same rangelands. What effects do cattle have on the behavior of the antelope?
- Determine turkey habitat requirements for nesting and brooding.
- Determine what effects current timber harvesting practices have on turkey productivity.

- Develop and refine techniques for manipulating size and structure of various wildlife species' populations, without threatening their viability.
- Determine the impact of disease and other non-human related factors in wildlife populations.

USDA PROGRAMS

FOREST SERVICE

National Forest System

The ongoing programs being implemented by the Apache-Sitgreaves and the Coconino National Forests (N.F.) include the Sykes Act, whereby specific habitat requirements are being determined, located, and mapped for various wildlife species. Vegetation type maps are being prepared which show the suitability of various habitats for wildlife. As an example, the Coconino N.F. is locating habitat requirements for the following cavity-nesting birds which winter in the ponderosa pine type; yellow-bellied sapsucker, hairy woodpecker, white breasted nuthatch, pygmy nuthatch, and northern three-toed woodpecker.

Both Forests are also locating, inventorying, and establishing key wildlife areas as management units. Surveys include the nesting habitat for the endangered bald eagle and peregrine falcon.

The Apache-Sitgreaves N.F. is conducting surveys to determine which species occur and the habitat requirement for the wildlife which inhabit the juniper-pinyon ecosystem. They are also conducting stream surveys to determine the presence or absence of Arizona native trout. Seven miles of stream improvement is being conducted on Arizona trout habitat. An inventory of instream fishery needs will be conducted.

Both Forests have ongoing wetlands management programs which include: construction of waterfowl nesting islands; seeding lands adjacent to water to vegetation preferred by waterfowl; and construction of fences to exclude livestock from waterfowl nesting and feeding areas.

On timber sales and fuelwood sales the National Forests are authorized to use a portion of the receipts for sale area improvement. These funds are used for planting, seeding, thinning, stand protection, and other activities needed to establish a new timber stand. The funds can also be used for protecting and improving the future productivity of other renewable resources on the timber sale areas. This includes, but is not limited to: planting or seeding of plant species for wildlife food and cover; prescribed burning for wildlife benefits; wildlife water improvements; stream improvement for fisheries; and manipulation of vegetation to enhance wildlife and fisheries habitat.

The Forests are placing increased emphasis on enhancing wildlife habitat through management of other forest and range resources. Fish and wild-

life biologists actively participate in planning and implementing timber sales, grazing activities, recreation developments, and forest management plans.

State and Private Cooperative Forestry Programs

The Arizona and New Mexico State Divisions of Forestry each provide technical assistance to private forest landowners for wildlife habitat management and improvement as a part of forest management. Arizona State Forestry currently is providing technical assistance to about 10 cooperators for wildlife habitat improvement on approximately 1,500 acres per year within the Basin. The assistance consists of recommendations for improving wildlife habitat through implementation of silvicultural practices.

Both States provide technical assistance to protect and conserve threatened and endangered plant and animal species through direct and cooperative programs in compliance with Section 7 of the Endangered Species Act of 1973.

SOIL CONSERVATION SERVICE

Assistance is provided to landowners who want to develop or improve wildlife habitat. This includes the full range of resource management systems that will provide the desired habitat components and that will control excessive erosion or water runoff. Wildlife habitat management is not a single practice, but is composed of many integrated practices that will provide food, water, and cover without decimating the resource base. The Soil Conservation Service approaches resource management from this "systems" point-of-view. Wildlife habitat management is a component of resource management systems on rangeland, cropland, wetlands, and woodland.

The Soil Conservation Service provides resource information and technical management assistance to aquaculturists. Included are basic water quality analysis, site suitability, and development design and culture techniques for the propagation of sport and food fish and bait animals. Assistance is provided to landowners interested in either recreational or commercial aquaculture.

SUPPLEMENTARY DATA

PERSONS CONTACTED FOR INFORMATION

Arizona Game and Fish Department

John Carr, Planning Division, State Office, Phoenix, Arizona
Bob Barsh, Planning Division, State Office, Phoenix, Arizona
T. L. Britt, Regional Game Specialist, Flagstaff, Arizona
Mike Yeager, Regional Supervisor, Pinetop, Arizona

New Mexico Division of Game and Fish

Gerald Gates, Planning Division, State Office, Santa Fe, New Mexico
Dick Raught, Game Management Specialist, Albuquerque, New Mexico

Arizona State Land Department

Bob Yount, Natural Resource Division, Phoenix, Arizona

New Mexico State Land Department

Duane Glidewell, Range Conservationist, Santa Fe, New Mexico

U.S. Fish and Wildlife Service

Terry Merkel, Fishery Biologist, Gallup, New Mexico
Tim Voelzer, Flyway Biologist, Albuquerque, New Mexico

Navajo Tribe

Ed Olsen, Fish and Wildlife Branch Manager, Window Rock, Arizona
John Antonio, Wildlife Biologist, Window Rock, Arizona

Zuni Tribe

Barton Martza, Game and Fish Manager, Zuni, New Mexico

Bureau of Indian Affairs

Marvin Jones, Hopi Agency, Keams Canyon, Arizona

Forest Service

Chuck Kennedy, Fishery Biologist, Albuquerque, New Mexico
Howard Hudak, Wildlife Biologist, Flagstaff, Arizona
Jim McKibben, Wildlife Biologist, Springerville, Arizona
Robert Lyle, District Ranger, Quemado, New Mexico

Bureau of Land Management

Joel Farrel, Socorro, New Mexico

INFORMATION CONCERNING FISHERIES ON THE
NAVAJO, HOPI, AND ZUNI INDIAN RESERVATIONS AND THE FORT WINGATE DEPOT

Navajo Indian Reservation

Antelope Lake: Built for watering livestock. Provides some put-and-take fishing for rainbow trout. Shallow and quite productive. Planted trout grow well but this lake cannot support many fish due to its small size. There are problems with submerged aquatic vegetation during summer, when the water level is low.

Assayi Lake: Constructed in 1964 on Bowl Creek to provide water based recreation for Camp Assayi and fishing for the general public and Tribal members. This is a fairly deep, onstream lake designed with a surface area of 36 acres. Sedimentation from the drainage area has been rapidly accumulating, so that by 1976 the lake already lost almost 20 percent of its storage capacity.

Bowl Creek: Upstream from Assayi Lake. Bowl Creek has sufficient flows to support a small trout population. Sedimentation has seriously degraded this stream. Protection of the watershed would benefit the trout population and in addition would lengthen the life span of Assayi Lake.

Ganado Lake: Constructed as an offstream irrigation reservoir. A shallow and highly productive body of water with considerable fishery potential. Water quality is excellent except for high pH levels during summer that are caused by submerged aquatic vegetation. A higher dam has been proposed which would impound more than 500 surface acres of water, but has been opposed by local land users who apparently do not want their grazing areas inundated. Currently the lake supports channel catfish, which are maintained by occasional plantings, and stunted largemouth bass. Bluegill have been introduced for forage, but it is not known whether they have become established. Consideration is being given to the introduction of northern pike. However, the lake has the potential to be an excellent put-and-take rainbow trout fishery if the existing warmwater fish can be eradicated and the depth can be increased.

Hidden Lake: A stock watering pond that was managed as a put-and-take rainbow trout fishery until the dam partially washed out. Currently it does not hold enough water to support a fishery. However, the Tribe is looking into the possibility of repairing the dam and enlarging the lake under the Resource Conservation and Development Program.

Mariano Lake: Once a major sport fishery in the Gallup area. Water quality excellent with the potential to grow trout well. However, the drainage area is too small so the lake often dries up. This problem was aggravated by the construction of numerous stock watering ponds in the drainage which prevent runoff from reaching the lake. During recent years, the lake had been dry more often than it contained sufficient water to sustain a fishery. The stock watering ponds have been accumulating silt and may be less of a problem in the future as their storage capacity diminishes.

Moenave Pond: This is a small pond located a few miles from Tuba City, Arizona, that at one time was stocked every spring with catchable size rainbow trout. Due to the Navajo-Hopi dispute, the lake is no longer under fishery management and has become infested with goldfish.

Pasture Canyon Reservoir: An irrigation reservoir with a maximum surface area of 36 acres, located near Tuba City, Arizona, in the disputed Joint Use area. It is spring fed, and has excellent water quality. It is highly productive but is not currently being managed for fishing due to the Navajo-Hopi dispute. At one time it was stocked with catchable rainbow trout and channel catfish, and both species did well.

Ramah-Navajo Agency Ponds: Six or seven stock watering ponds that are planted with catchable rainbow trout and occasionally channel catfish, and are the only fisheries in the Ramah-Navajo Agency area. These ponds generally are turbid and do not have much fishery potential. About all they do is satisfy some of the local Navajo demand for recreational fishing. The local Navajos are looking for a site to build a medium or large size fishing lake but have not located one so far.

Red Lake: A large, shallow, muddy, offstream irrigation reservoir that at one time was a good put-and-take rainbow trout fishery but which currently has little fishery value. The fish population now mostly consists of black bullheads with some channel catfish and a few brown trout. Attempts have been made to establish northern pike and largemouth bass. This lake is accumulating enormous quantities of sediment from Todilto Wash due in part to improper operation and maintenance of the diversion structure. According to a study by Chambers and Cambell, the lake could be made smaller and deeper. This would substantially improve it as a fishery.

Sawmill Pond: A shallow stock watering pond that does not hold water. During years of adequate runoff, this pond provides some fishing for rainbow trout, but during dry years submerged aquatic vegetation becomes a serious problem.

Trout Lake: Another shallow impoundment that loses water rapidly from seepage. Dries up completely during prolonged dry spells but is a good rainbow trout fishery during those occasional years when there is plenty of runoff.

Upper Sawmill Pond: A stock watering pond which provides some local put-and-take rainbow trout fishing during years of adequate runoff.

Hopi Indian Reservation

Keams Pond: There are two Keams Ponds, Upper and Lower. Upper Keams Pond has almost completely filled with sediment and is no longer a fishery. Lower Keams Pond is stocked each year with catchable rainbow trout and occasionally with catchable channel catfish. Substantial demand for recreational fishing exists in the area and consideration is being given to construction of another fishing pond within Keams Canyon.

Tuve Reservoir: This irrigation reservoir of approximately 20 surface acres was recently constructed on Hopi lands near the Village of Moenkopi. An excellent put-and-take rainbow trout fishery could be established there. However, due to problems attendant with the reservoir's being located adjacent to the area disputed by the Hopi and Navajo Tribes, there are no plans to allow fishing until a Hopi fish and game code has been adopted.

Zuni Indian Reservation

Black Rock Lake: This irrigation reservoir is badly silted and had been much deeper at one time. It is shallow and supports too much submerged aquatic vegetation to be a trout fishery. Currently the fish population consists mainly of green sunfish and fathead minnows. High pH levels have eliminated all or most of the rainbow trout that were planted experimentally. Northern pike appear to be successfully reproducing but their numbers are limited. With adequate depth to prevent weed growth and with elimination of the existing fish population, this lake could be an excellent put-and-take rainbow trout fishery.

Eustace Lake: Contains self-sustaining populations of green sunfish, largemouth bass, and northern pike. Channel catfish are planted occasionally. This could be a good put-and-take rainbow trout fishery if green sunfish could be eradicated from the drainage.

Galestena No. 1 and No. 3: Constructed for purposes of erosion control. These are put-and-take rainbow trout fisheries. Number 3 has accumulated much sediment and may no longer be suitable for stocking.

Nutria No. 4 Lake: This is an offstream reservoir but is badly silted. Due to its shallow depth, there are occasionally excessive amounts of submerged aquatic vegetation present during the summer months. However, only a few fish kills have occurred and these have been minor. Also, because of the lake's shallow depth the water becomes turbid during windy periods, which are frequent in this area. Despite its problems, this lake is the most popular fishery on the Reservation and must be stocked heavily each year with catchable size rainbow trout to meet angler demands.

Nutria No. 2 Lake: Covers approximately 400 surface acres when full. It has accumulated a large amount of silt, primarily from Coalmine Canyon, and is quite shallow with an abundance of submerged aquatic vegetation during the summer months. This lake is an excellent put-and-take rainbow trout fishery during the years of adequate runoff, but the accumulation of sediment each year is gradually destroying it.

Ojo Caliente Lake: Probably the second most popular fishery on the Reservation. This lake is stocked with rainbow trout and channel catfish on a put-and-take basis. The fish that are not soon caught grow rapidly and attain excellent condition. The water has an abundance of bulrushes and submerged aquatic vegetation. These are not a problem unless there are excessive drawdowns for irrigation or for watering of livestock downstream. The lake is spring fed and the water quality is excellent.

Pescado Lake: Due to extreme muddiness of the water, this lake is not a good fishery. It has been stocked in the past with rainbow trout and channel catfish. The trout did not grow well, but the catfish reached fairly large size. Generally, fishermen avoid this lake because of its unpleasant appearance.

Fort Wingate Depot

Knudson Lake: The maximum surface area is about 8 acres. This is an offstream impoundment that is filled by diverting runoff from a 26 square mile watershed. Much of the lake's storage capacity has been lost due to sedimentation. Water levels are extremely low during periods of prolonged drought. Also, the water remains muddy most of the time. This lake is stocked on a put-and-take basis with rainbow trout and channel catfish. Sedimentation is destroying the fishery.

McFerren Lake: Maximum surface area is about 2 acres. This is a good put-and-take rainbow trout lake that supports a few channel catfish. Its fishery potential is limited due to its small size.

Source: Terrence J. Merkel
Fishery Management Biologist
U.S. Fish and Wildlife Service
Gallup, New Mexico

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SECTION 3

TIMBER

SECTION 3

TIMBER

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SECTION 3

TIMBER

INTRODUCTION

The Little Colorado River Basin encompasses 17,256,960 acres, of which 13,866,880 acres are within Arizona containing portions of Coconino, Navajo, and Apache Counties. The remaining 3,390,080 acres are in western New Mexico; San Juan, McKinley, Valencia, and Catron Counties (See Table 3-1 for acreage by ownerships and map following page 3-2 for location).

Most of the 1,417,925 acres of commercial timber land is located on the Mogollon Rim along the southern edge of the Basin. This is 8 percent of the Basin area (Refer to the Vegetation Cover map in Section 2 of this Appendix). Ownership of commercial timber land is: 78 percent National Forest; 17 percent Indian; 4.5 percent private, and 0.5 percent State.

There are 5,277,738 acres of juniper-pinyon woodlands in the Basin. This is 31 percent of the Basin area. Ownership is: 43 percent Indian; 26 percent Federal; 22 percent private, and 9 percent State.

This study includes existing inventories of forest and woodlands and presents management guidelines to promote forest and woodland management. The report also provides information on markets for forest products, protection of forested land, reforestation, and future management goals.

The multiple use and management of water, land, and related resources have created many complex interrelationships and problems. This study addresses some problems of conserving and developing forest and woodland resources to maximize the economic and environmental concerns expressed by the public and the sponsors of this study.

PRESENT SITUATION

VOLUME BY SPECIES AND LAND OWNERSHIP

Table 3-2 shows the acres and volumes of forest land by ownerships. Table 3-3 shows acres and volumes by tree species. Inventories for National Forest, Navajo Reservation, and Zuni Reservation timbered lands are available. Inventories for State and private forest lands in the Basin are not complete. The Arizona and New Mexico State Forestry Divisions are currently preparing State Forest resource plans. These plans will include current inventory information and schedules for completing Statewide inventories.

Ponderosa pine is the dominant species, growing between 5,500 and 8,000 feet in elevation, in a basically pure type. Mixed conifer occurs from approximately 8,000 to 12,000 feet in elevation.

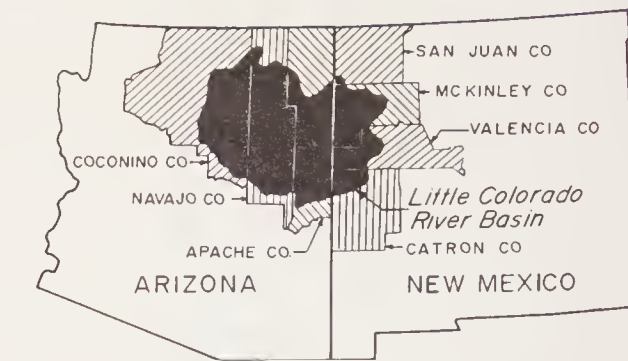
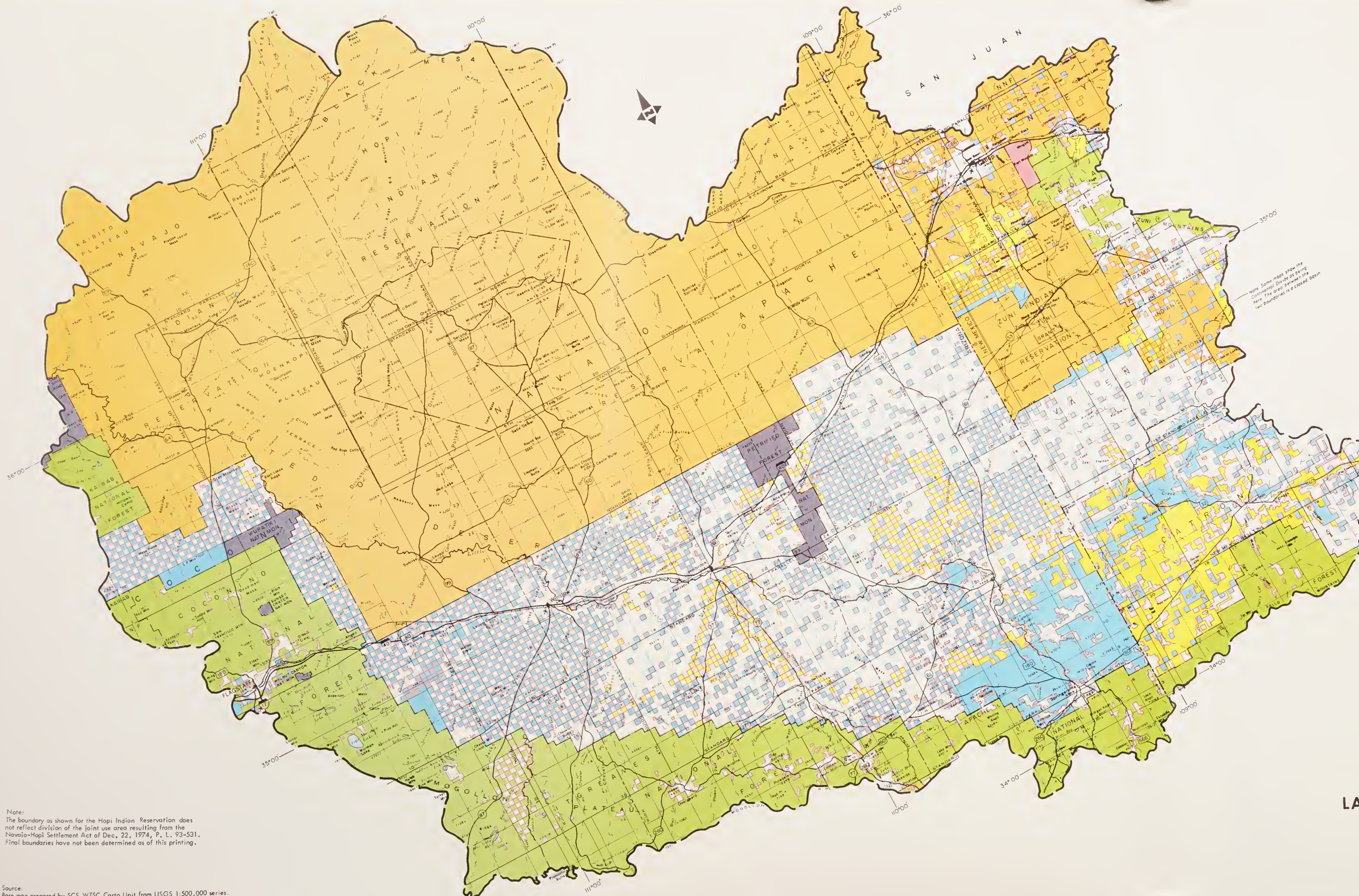


Photo 3-1: Southwestern ponderosa pine



Photo 3-2: Mixed conifer occurring above 8,000 feet

Juniper-pinyon woodlands occur throughout the Basin, generally between 4,500 and 7,000 feet in elevation. Federal and State agencies only recently recognized the need to inventory and develop management guides for pinyon and juniper trees. The Arizona State Land Department conducted a fuelwood inventory of juniper-pinyon woodland type for State and private lands within Navajo and Apache Counties in 1977. Inventories and planning are currently underway on Indian trust, BLM, and National Forest lands. Table 3-3 shows existing data.



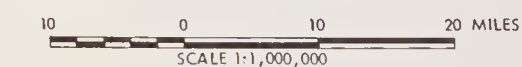
LOCATION MAP

LEGEND

- National Forest Service
- Bureau of Land Management
- National Park Service
- Department of Defense
- State Trust
- State Parks, Game & Fish Dept.
- Individual & Corporate
- Indian Lands

LAND OWNERSHIP AND ADMINISTRATION
LITTLE COLORADO RIVER BASIN
ARIZONA AND NEW MEXICO

1979



Note:
The boundary as shown for the Hopi Indian Reservation does not reflect division of the joint use area resulting from the Navajo-Hopi Settlement Act of Dec. 22, 1974, P. L. 93-531. Final boundaries have not been determined as of this printing.

Source:
Base map prepared by SCS, WTSC Carto Unit from USGS 1:500,000 series.
Thematic detail compiled by state staff.
U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE
USDA-SCS-PORTLAND OR 1980



Photo 3-3: Juniper-Pinyon Woodlands

T A B L E 3-1

LAND OWNERSHIP AND ADMINISTRATION BY ACRES - 1979
LITTLE COLORADO RIVER BASIN ^{1/}

OWNERSHIP AND ADMINISTRATION	ARIZONA	NEW MEXICO	TOTAL
FEDERAL			
Forest Service	2,062,470	304,240	2,366,710
BLM	232,770	520,830	753,600
National Parks	164,150	1,280	165,430
Defense Dept.	0	21,920	21,920
Total	2,459,390	848,270	3,307,660
STATE			
State Trust	1,323,810	428,870	1,752,590
Other State	12,310	0	12,310
Total	1,336,120	428,780	1,764,900
Indian	7,115,870	1,086,880	8,202,750
Private	2,955,500	1,026,150	3,981,650
TOTALS	13,866,880	3,390,080	17,256,960

^{1/} As determined by the Soil Conservation Service for this River Basin Study.

T A B L E 3-2

Commercial and Non-Commercial Forest Lands
by Ownership, Little Colorado River Basin
Acres and Volumes (1,000 Bd. Ft.)

ARIZONA

Land Ownership	Commercial		Non-Commercial		Total	
	Acres	Volume	Acres	Volume	Acres	Volume
Private	45,524	307,572	0	0	45,524	307,572
State	5,120	34,596	0	0	5,120	34,596
Industry	0	0	0	0	0	0
Indian	196,721	1,311,055	0	0	196,721	1,311,055
Forest Service	969,700	5,333,000	53,000	78,800	1,022,700	5,411,800
BLM	0	0	0	0	0	0
TOTAL	1,217,065	6,986,223	53,000	78,800	1,270,065	7,065,023

NEW MEXICO

Private	17,900	51,370	3,100	5,990	21,000	57,360
State	0	0	1,200	2,300	1,200	2,300
Industry	0	0	0	0	0	0
Indian	46,180	136,600	0	0	46,180	136,600
Forest Service	136,780	405,540	24,400	49,400	161,180	454,940
BLM	0	0	600	1,150	600	1,150
TOTAL	200,860	593,510	29,300	58,840	230,160	652,350

T A B L E 3-2 (continued)
Commercial and Non-Commercial Forest Lands
by Ownership, Little Colorado River Basin
Acres and Volumes (1,000 Bd. Ft.) ^{1/}

TOTAL ARIZONA AND NEW MEXICO

Land Ownership	Commercial		Non-Commercial		Total	
	Acres	Volume	Acres	Volume	Acres	Volume
Private	63,424	358,942	3,100	5,990	66,524	364,932
State	5,120	34,596	1,200	2,300	6,320	36,896
Industry	0	0	0	0	0	0
Indian	242,901	1,447,655	0	0	242,901	1,447,655
Forest Service	1,106,480	5,738,540	77,400	128,200	1,183,880	5,866,740
BLM	0	0	600	1,150	600	1,150
TOTAL	1,417,925	7,579,733	82,300	137,640	1,500,225	7,717,373

Source: Forest Service - Timber Management plans for Apache, Sitgreaves, and Coconino National Forests.

Indian Lands - Bureau of Indian Affairs, Navajo Area Office and Albuquerque Area Office.

Bureau of Land Management - Estimated from mapped acres.

State and Private - Estimated from mapped acres and from limited inventories.

TABLE 3-3

ACREAGES AND VOLUMES ^{1/} OF TREE SPECIES IN
THE LITTLE COLORADO RIVER BASIN BY
OWNERSHIP AND STATE ^{2/}

Arizona

Tree Species	Acres			Volume				
	Private	State	Indian	Federal	Private	State	Indian	Federal
Ponderosa Pine	45,524	5,120	192,905	945,200	307,572	34,596	1,293,113	5,857,500
Poletimber 5" - 11"	-	-	-	52,600	223,776	25,176	-	456,500
Sawtimber 12" +	-	-	-	892,600	83,796	9,420	-	5,401,000
Mixed Conifer	0	0	3,816	24,500	0	0	17,942	155,500
Poletimber 5" - 11"	0	0	-	2,200	0	0	-	4,500
Sawtimber 12" +	0	0	-	22,300	0	0	-	151,000
Juniper-Pinyon ^{3/}	241,134	140,212	1,386,327	903,910	1,098,537	643,026	6,868,969	3,938,710
% Crown Density 0-25	45,466	38,413	1,386,327	85,040	0	0	0	0
26-50	92,100	40,507	-	387,000	317,744	139,749	-	955,880
51-75	71,794	31,674	-	261,180	457,330	201,765	-	1,603,640
76-100	31,774	29,618	-	170,690	323,463	301,512	-	1,379,190

TABLE 3-3 (continued)

New Mexico 2/

Tree Species	-----Acres-----			-----Volume-----				
	Private	State	Indian	Federal	Private	State	Indian	Federal
Ponderosa Pine	20,500	1,200	46,180	161,780	56,360	2,300	136,600	456,090
Poletimber 5" - 11"	5,120	400	-	41,080	8,460	350	-	95,420
Sawtimber 12" +	15,380	800	-	120,700	47,900	1,950	-	360,670
Mixed Conifer	0	0	0	0	0	0	0	0
Poletimber 5" - 11"	0	0	0	0	0	0	0	0
Sawtimber 12" +	0	0	0	0	0	0	0	0
Juniper-Pinyon ^{3/}	880,990	349,430	899,240	476,495	4,056,302	1,705,062	4,558,866	2,224,790
% Crown Density 0-25	36,450	24,420	39,160	31,155	0	0	0	- 0
26-50	358,400	125,580	326,800	190,040	885,240	310,191	810,050	469,397
51-75	390,170	111,630	296,900	159,440	2,395,665	685,403	1,833,606	980,805
76-100	95,970	87,800	236,380	95,860	775,397	709,468	1,915,210	774,588

TABLE 3-3 (continued)

Total Arizona and New Mexico

Tree Species	Acres			Volume				
	Private	State	Indian	Federal	Private	State	Indian	Federal
Ponderosa Pine	66,024	6,320	239,085	1,106,980	363,932	36,896	1,429,713	6,313,590
Poletimber 5" - 11"	-	-	-	93,680	232,236	25,526	-	551,920
Sawtimber 12" +	-	-	-	1,013,300	131,696	11,370	-	5,761,670
Mixed Conifer	0	0	3,816	24,500	0	0	17,942	155,500
Poletimber 5" - 11"	0	0	-	2,200	0	0	-	4,500
Sawtimber 12" +	0	0	-	22,300	0	0	-	151,000
Juniper-Pinyon ^{3/}	1,122,124	489,642	2,285,567	1,380,405	5,154,839	2,348,088	11,427,835	6,163,500
% Crown Density 0-25	81,916	62,833	1,425,487	116,195	0	0	0	0
26-50	450,500	166,087	326,800	577,040	1,202,984	449,940	-	1,425,277
51-75	461,964	143,304	296,900	420,620	2,852,995	887,168	-	2,584,445
76-100	127,744	117,418	236,380	266,550	1,098,860	1,010,980	-	2,153,778

1/ Ponderosa pine and mixed conifer volumes by 1,000 bd. ft., juniper-pinyon by cords.

2/ Source: Timber Management plans for Apache, Sitgreaves, Cibola, and Coconino National Forests

Bureau of Indian Affairs, Navajo Area Office and Albuquerque Area Office

Arizona State Land Department, Division of Forestry

Estimates from mapped acres for BLM lands and New Mexico State and private lands.

3/ Acres in crown density categories and volumes were estimated, using personal knowledge and information from the Arizona State Land Department study in Apache & Navajo Counties.

PRIME FOREST LAND

There are no known timberlands with the capability of growing wood at the rate of 85 cubic feet or more/acre/year mean annual increment. There are possibly a few sites within the mixed conifer and spruce-fir vegetation zones with the potential of meeting the prime forest land criteria of 85 cubic feet/acre/year.

PRODUCTION AND WOOD PRODUCTS MARKETS

The timber industry in Arizona has increased dramatically in the past decade. Over the last 10 years sales have risen 20 percent, employment 214 percent, and payrolls 363 percent (12). These increases reflect Arizona's growing population and economy which are demanding ever-increasing quantities and varieties of wood products. Since 1967, the population of Arizona has risen 44 percent, Coconino County has risen 35 percent, Navajo County 39 percent, and Apache County 28 percent. Population projections to the year 2000 predict an increase in Arizona of 151 percent, Coconino County 200 percent, Navajo County 161 percent, and Apache County 151 percent over 1967 levels (Arizona Statistical Review, 1978). This represents a serious challenge to Arizona's forest industry.

In 1978, Arizona mills produced 350 million board feet of lumber. Ponderosa pine accounted for 87 percent of the total with Douglas-fir accounting for 10 percent, white fir 2 percent, and Engelmann spruce 1 percent. The estimated wholesale value of this lumber was \$113,500,000 with approximately 99.5 percent of the timber coming from Federal lands and .5 percent from State and private lands (14). Production of mills within the Basin is not available. However, an estimated 50 percent of Arizona's production is harvested from the Little Colorado River Basin.

Other forest products from the Little Colorado River Basin include liner and particle board, newsprint, house logs, and aspen shakes. In 1978, the paper mill at Snowflake, Arizona, produced 137,000 tons of newsprint and 236,000 tons of craft linerboard for a total value of \$93,800,000 (Mike Moore, Paper Products Group Comptroller, Southwest Forest Industries, Phoenix, Arizona). An estimated 60 percent of the wood and fiber used in the paper mill is harvested in the Basin.

Other forest products from the Basin include house logs and aspen shakes. There is also interest in utilizing old pine stumps for development of naval stores.

Because there is a high percentage of low-grade material harvested in the Basin's forests, little can be utilized for structural purposes. Most must be used for ties, moulding, shop, or secondary manufactures. Much of the material used for structures, cabinets, furniture, etc., must be brought into the State.

A vast forest resource that has not been fully appreciated, utilized, or managed is the juniper-pinyon woodlands. Because the demand for fuelwood in Arizona has risen 400 percent since 1973, studies are being conducted to determine the best method of management for the woodland types (see page 36, Reference 6).

Data for determining total fuelwood harvest within the Basin is unavailable. The following figures show a portion of the harvest in 1978:

TABLE 3-4

1978 Fuelwood Harvest in the
Little Colorado River Basin 1/

<u>Land Ownership</u>	<u>Fuelwood Sold-Cords</u>	<u>Fuelwood Free Use-Cords</u>	<u>Stumpage Value</u>
Arizona State Lands	1,970	-	\$ 3,000
Coconino National Forest	350	24,000	\$ 36,000
Apache-Sitgreaves National Forests	<u>3,700</u>	<u>47,000</u>	\$ <u>80,000</u>
Totals	6,020	71,000	\$119,000

1/ Based on Forest Service and State Land Department permit records. Fuelwood is harvested on private, Indian, and BLM lands, but amounts are unknown.

With proper management, pinyon pine could be used for pulpwood in the future. Other products from the woodlands include charcoal, fence posts, pinyon nuts, and Christmas trees.

There are 18 mills operating in the Basin, including 17 in Arizona and 1 in New Mexico at Pietown, producing a wide variety of products (see Table 3-5). These mills face many of the same problems that the timber industry faces nationwide; such as:

1. Shortage of pulpwood and sawtimber.
2. Inability to meet increasing demands for products of all types.
3. Increasing government restrictions due to environmental, recreational, and wilderness demands.
4. Increased competition for available timber.
5. Rising costs.
6. The older sawmills were built for large sawlogs and cannot efficiently saw today's small diameter logs.

TABLE 3-5
LITTLE COLORADO RIVER BASIN SAWMILL DATA BY PERCENTAGES, ARIZONA

MILL TYPE	NUMBER OF MILLS (17)	PERCENT OF MILLS	DISTRIBUTION CHANNEL	NUMBER OF MILLS (17)	PERCENT OF MILLS
Stationary-fulltime	12	71	Secondary Mfg'r	6	35
Stationary-parttime	4	23	Wholesalers	14	82
Portable	1	6	Own use	4	23
SPECIES PROCESSED	(17)		Own retail	9	53
Ponderosa pine	14	82	Retailers	6	35
Douglas-fir	8	47	Loghouse kits	1	6
White fir	7	41	Publishers	1	6
Corkbark fir	1	6			
Engelmann spruce	4	23			
Aspen	3	18			
DEGREE OF PROCESSING	(16)				
Air dry	9	56			
Kiln dry	8	50			
Green	8	50			
Rough	8	50			
Surfaced	10	62			
PRODUCT	(17)				
Dimension	15	88			
Timbers	11	65			
Ties	5	29			
Shop	3	18			
Moulding	4	23			
Posts	1	6			
Poles	1	6			
Studs	4	23			
Shakes	1	6			
House logs	1	6			
Newsprint	1	6			
Kraft liner bd.	1	6			
Particle board	1	6			

Source: Arizona State Land Dept.
Divison of Forestry

Notes:

- (1) Numbers and percentages of mills will not total due to within mill usages of various species, processing methods, products, and distribution channels.
- (2) The one New Mexico mill within the Basin, at Pietown, produces pinyon ties and ponderosa pine timbers.

SILVICULTURAL PRACTICES

Ponderosa Pine

The majority of the timber stands in the Basin are ponderosa pine with an intermediate story of Gambel oak. At low elevations juniper is found mixed with pine and at higher elevations Douglas-fir and aspen sometimes occur with the pine.

Ideally, a pure stand such as Southwestern ponderosa pine would be managed using the even-aged method. This method is oriented towards timber production and in pure stands is the easiest management technique. In an even-aged stand all trees are the same age or age class. A stand is considered even-aged if the difference in age between the oldest and the youngest trees does not exceed 20 percent of the length of the rotation.

Two methods of harvesting, seed tree and clearcut, are most readily applicable to even-aged stands. The seed tree method is like the clearcut method except that certain uniformly distributed trees are left standing for the purpose of furnishing seed to restock the cutover area naturally. (In clearcutting, the cutover areas are usually artificially seeded or planted to restock them.) After a new crop is established, seed trees may be removed in a second cutting or left indefinitely. When using the seed tree method there are no restrictions on the size and arrangement of cutting areas because adjacent stands are not depended upon as seed sources.

The acceptable harvesting practice used in the Southwest is the shelterwood method. This involves the gradual removal of the entire stand in a series of partial harvests, which resemble heavy thinnings, over a fraction of the rotation. Under protection of the overstory, reproduction starts and is released when it becomes desirable to give the new crop full use of the growing space. In the shelterwood method a new crop is established before completion of the preceding rotation.

The shelterwood method is actually a further development of the seed tree method in which sufficiently large numbers of seed trees are retained to protect the site as well as to provide seed. Regeneration periods as long as 40 to 60 years may sometimes be used in stands that are managed on long rotations. With a regeneration period of such length, the individual trees of the new stand will have a relatively wide range of age, although the stand remains more nearly even-aged than otherwise and is managed as such.

The primary objective of timber management for both the States of Arizona and New Mexico is to obtain continuous production at a level as high as is economically and ecologically possible. As stated in the Arizona Timber Management Plan, some specific activities to accomplish this include:

- I. Even-aged management principles will be utilized. The rotation period for seedling to sawlog maturity for timbered areas will be 120 years. The cutting interval will be 40 years, based on a modified shelterwood method.

The rotation age will depend upon how soon reproduction is established. Ideally, a 5-year period should suffice for natural reproduction to appear, and a maximum of 10 years will be allowed for establishment of adequate reproduction.

- II. Design stand harvesting prescriptions to obtain suitable management of the younger age classes, according to site quality of the individual stand.
- III. Obtain maximum utilization of all usable cutting practices.
- IV. Reforest burned areas, other nonstocked areas, and poorly stocked areas that are suitable.
- V. Reduce disease in stands through sound cutting practices.
- VI. Obtain maximum utilization of all usable dead or deteriorating timber as fully as possible. A recent inventory indicates a high degree of mortality in Keen's III and IV classes (9). A concentrated effort will be made to capture and reduce this mortality.
- VII. Reduce overstocked stands to the optimum stocking compatible with the site quality.
- VIII. Increase understocked stands to the optimum stocking through planting, direct seeding, or by helping natural regeneration by site preparation.
- IX. Improve the quality of the stands through thinning, commercial intermediate cuts, and regeneration from selected seed sources with better genetic qualities.

At the present time, Arizona is using a modified shelterwood method with the aforementioned activities. Because State lands are checkerboarded with Forest Service land, each section of forest land is treated separately from all others. Management plans are based upon a section's particular characteristics including current stocking levels, site index, soil type, age, condition of stand, insect or disease problems, and any special consideration such as aesthetics, grazing, water runoff, recreation, and wildlife.

One major benefit of this method is a reduction in the fire hazard. When the stand is selectively harvested and thinned, all slash is piled or lopped and burned. In broadcast burning, duff is consumed thereby effectively preventing a ground fire from moving through the stand.

Ponderosa pine stands on National Forest lands are managed with the regular shelterwood method. The cutting intervals are 20 years except in special components where tree removal is usually in the form of salvage harvest. The Navajo Forest is also managed with the shelterwood method (Refer to the Supplementary Data section of this report for information on the management of the Navajo Forest.)

Juniper-Pinyon

In the past, vast woodland areas were cleared of trees in attempts to eradicate the pinyon and juniper and revert the areas to grasslands. Although these woodland areas are of less commercial value than the sawlog forests of higher elevations, they represent a vast potential for fuelwood and miscellaneous products.

The woodland species have been utilized longer and more intensively for fuelwood than for any other product. The current energy crisis, together with rapidly increasing fossil fuel costs and increased popularity of woodstoves and fireplaces, is generating a large demand for fuelwood. While it is often not feasible for most people to convert entirely to fuelwood, the use of this natural resource as a supplementary source of energy could substantially reduce heating costs. From 1973 to 1978, the demand in Arizona for fuelwood has increased over 400 percent. Aside from fuelwood, the woodlands also furnish Christmas trees, fence posts, pinyon nuts, and wood for specialty products.

Current management plans are aimed at retention of the natural aspect (original vegetative type of the land) and the practice of "vegetative manipulation" rather than "type conversion" or eradication of trees over a large area.

Tracts of State and private land are clearcut in such a way as to leave irregular shaped buffer strips of trees. The clearcut areas establish a cover of grass and forbs which benefit livestock and larger game animals. The buffer zones provide cover and food for smaller animals and birds as well as the grazing animals.

Using this method, a monetary benefit can also be realized through the sale of fuelwood. Not only are more resources benefited this way, but fuelwood and other products are made available to the public.

For more intensive and effective management in the future, more must be learned about the juniper-pinyon woodland type. To meet these goals, future inventories might include:

1. Growth studies for the purpose of determining an allowable cut on a sustained yield basis.
2. An inventory to identify the particular areas which may be suitable for harvesting other wood products such as pinyon pine for pulpwood.

3. Juniper for dimensional lumber specialty products.
4. Sites where pinyon is optimum for Christmas trees.
5. Areas classified according to their forage producing and grazing potential.
6. Areas within the type that have recently been eradicated to increase forage production and may have contained dry seasoned commercial firewood.
7. A map showing development of ranch units to improve woodland range through tree control.
8. Revegetation of overgrazed areas and development of grazing systems to prohibit future overgrazing, which has reduced herbaceous ground cover and led to increased tree density.
9. Coordination between agencies to identify areas of wildlife habitat and guidelines to improve it such as leaving ridges and steep slopes untreated.

Therefore, the juniper-pinyon type can be modified and managed to provide a mix of products, forage, habitat, fuelwood, fence posts, pinyon nuts, Christmas trees, and aesthetically pleasing surroundings.

PROTECTION

Insect and Disease

Dwarf mistletoes are undoubtedly the principal destructive agents present in the Little Colorado River Basin. Southwestern dwarf mistletoe on ponderosa pine and Douglas-fir dwarf mistletoe cause the greatest losses to private, State, Indian, and Federal forest lands. Dwarf mistletoe effects include growth loss (i.e., height, volume, diameter), reduced seed production, reduced wood quality, predisposition of infected trees to other forest pests and eventual mortality. In addition, infected stands may undergo change in composition brought about by the tree losses.

However, dwarf mistletoes have evolved along with their hosts and are an integral part of the ecology. Control efforts should be directed at reducing their effects and not at complete eradication. Dwarf mistletoes are present throughout the Basin wherever the hosts occur. Infection levels may depend on a combination of factors including site quality, host vigor, stand density, stand age and size class, stand composition, and stand history (fires, logging, etc.). Control can be achieved through sanitation thinnings, clearcuts followed by regeneration, conversion to two-storied stands, and by pruning where practical and economical. A combination of treatments may be utilized depending on the timber management plan. Management of dwarf mistletoe infected stands should be a top priority in the Little Colorado River Basin.

Bark beetles have periodically caused damage to timber stands in this area. IPS, spruce, Douglas-fir, and western pine beetles have reached epidemic levels in the past.

A spruce beetle outbreak occurred in the Inner Basin area in the San Francisco Peaks in 1974. The infestation was triggered by avalanche-damaged spruce trees. Salvage logging of the infested material was implemented and no further problems with this beetle have been reported.

Spruce beetle outbreaks have also occurred on Mt. Baldy and Escudilla Mountain. Suppression of outbreaks on Mt. Baldy were achieved by extremely low temperatures or through sanitation-salvage logging. Ips bark beetles have caused scattered ponderosa pine mortality in the Basin. Logging and thinning slash, stumps, and trees weakened by burning slash have contributed to the buildup of these insects. Areas around Flagstaff, Pinedale, and Springerville have experienced problems with this beetle.

Prevention techniques involve proper timing of silvicultural activities, utilization of material down to a 4-inch top, and prompt disposal of slash, cull logs, or other debris.

Direct control of Ips beetles includes burning, chipping, or debarking infested slash or covering material with plastic to create lethal temperatures. Chemical treatment can also be utilized, but is usually too expensive, impractical, or both.

Pine needle miners are becoming an increasing concern on ponderosa and pinyon pines in the Little Colorado River Basin. Damage to ponderosa pine in the Showlow-Lakeside area has been noted since 1976. The population was probably present prior to this date, but was not visibly noticeable. Largest area of infestation covers about 2,000 acres with scattered populations throughout the area. The yearly defoliation has not caused any tree mortality, but the continual loss of foliage becomes increasingly damaging with each passing year. Loss of needles, shortened new growth, and reduction in stem and shoot growth may eventually cause death or initiate attack by secondary pests.

Pine needle miners were also detected in the Cross Canyon area west of Window Rock in 1978. The needle miner is attacking pinyon pine and has caused mortality to older trees less able to recover from the yearly defoliation. Needle miner on pinyon pine was reported near Gallup, New Mexico in 1975. No follow-up examinations of this population have occurred and their current status is unknown. It is apparent that this insect is scattered throughout the Little Colorado River Basin and may become a serious problem in the near future. Hopefully, natural enemies, disease, and climatic extremes will prevent these populations from ever becoming epidemic.

Pine tip moths are very common on both natural and planted ponderosa pines in the Little Colorado River Basin. Damage is caused by the feeding activity of the larva (caterpillar) within the pine tip. They are especially damaging to reseeded and planted burns. Repeated attacks

impede height growth and create bushy, multibranched trees. In 1956, a 21,000 acre fire occurred south of Winslow. Most of the area reseeded naturally, but large open areas were planted with ponderosa pine. The young seedlings, both natural and planted, were quickly infested with tip moths. Although the damage continues to occur, trees which are now past 6 to 8 feet are less susceptible to attack. Several parasites and predators have been collected from tip moth-infested trees; however, pest populations are high enough to offset any losses that may occur. Control of the tip moths can be realized through the use of carefully timed systematic insecticide applications. However, this type of treatment would be impractical on a large-scale basis.

Urbanization in forested areas of the Basin has a significant impact on timber resources. Trees stressed, damaged, or killed by construction could precipitate an insect or disease problem on adjacent private, State, Indian, or Federal lands. Subdivision construction near Flagstaff, Heber-Overgaard, and Showlow-Lakeside-Pinetop cause the most problems. Proper precautions are not taken by the building contractors and many needless tree losses occur. Much of this loss could be avoided with increased publicity and dissemination of information on the subject. With the yearly increase in construction in these areas, the problem can only become worse.

Numerous other forest insects have been detected in the Basin. Spruce budworm has been a problem on the Navajo Reservation north of Window Rock. Current populations are at low levels and pose no serious threat. Tent caterpillars caused defoliation to aspen stands near Mormon Lake in 1975. However, most trees refoliated during late summer. Conifer sawfly has been causing damage to pulp-size trees west of Springerville since 1977. The site is marginal for ponderosa pine and adjacent stands do not show any signs of sawfly defoliation. Tiger moth was very widespread on ponderosa pine from Flagstaff through Pinetop in 1978. Defoliation was insignificant since most of the infested trees were large and the damage was slight. Spruce gall aphids, spiny elm caterpillars, and pine needle scale have been identified throughout the area. They do not pose a serious threat to the forest resource at this time.

Minor forest diseases that can be found in the Basin include Armillaria root disease; limb rust, trunk, butt, and root rots; juniper, spruce, and fir broom rusts; and diseases of aspen. Red heart rot was identified on 15 to 25 percent of the merchantable ponderosa pine northeast of Window Rock in 1968. The study was completed to reduce red rot losses through silvicultural means. Because of the low humidities present in Arizona, it is unlikely that any of the above-mentioned diseases will ever reach damaging proportions.

Most of the insect and disease problems that might arise in the Basin can be prevented through various techniques. Hopefully, those techniques will be applied before a problem arises. Prevention is much more effective, economical, and environmentally acceptable.

Fire

Fire continues to be the proverbial sword hanging over everyone's head within the forested Basin area. Unusually high winter and spring precipitation causes an abnormally high amount of forest understory growth which in turn contributes to a high fire hazard during the fire season. Failure of the annual rainy season to bring adequate moisture also adds to an already high fire danger.

Lightning causes 62 percent of the fires on the Coconino National Forest and 75 percent of the fires on the Apache-Sitgreaves National Forests, with man-caused fires accounting for 38 percent and 25 percent, respectively.

At the present time nothing can be done about the high incidence of lightning strikes in the Basin, but much can be done about man-caused fires. Through intensive public awareness programs such as the Smokey Bear Fire Prevention program, conducted in cooperation with the U.S. Forest Service, the public is more aware of wildfire dangers than ever before. The Southwest Interagency Fire Council was set up to coordinate presuppression, prevention, and suppression measures between State, Federal, and local agencies in Arizona and New Mexico. In addition the Council coordinates and publicizes Forest closures and works for greater public awareness.

Prescribed burning and timber stand improvement measures, such as thinning and pruning, continue to be excellent methods of reducing fire hazard in stands. Construction and maintenance of firebreaks, fire suppression lanes, and fuelbreaks are also good insurance in forested areas. Cost-share programs such as FIP and ACP are available for timber stand improvement measures with technical assistance by the State Land Department.

Protection of forested lands, improvements, and private holdings is increasing. Through cooperative agreements with fire districts and associations, the States provide fire fighting equipment in the form of reconditioned surplus military vehicles and pumper units for response to any fires on State or private land within the organization's area of protection. The States also conduct wildfire suppression training courses for rural fire fighters. Fire crews and equipment are on 24-hour standby during the fire season for statewide purposes.

The U.S. Forest Service and Bureau of Land Management (BLM) have access to large numbers and varieties of manpower and equipment. Helitack and hotshot crews stand by for quick initial attacks on wildfires with additional air and ground troops and equipment responding as needed. Presently the States contract with the Forest Service for fire protection on its timber trust lands. The Forest Service and BLM also respond to wildfires threatening Federal lands. There are cooperative agreements between communities and the Forest Service, whereby a fire department will respond to fires on Federal land.

Table 3-6 shows most of the fire departments within the Arizona portion of the Basin as of August 30, 1979. Reservation fire departments are not listed.

FORESTATION

The Basin area has many of the same regeneration problems as the rest of the Southwest, such as drought, short growing season, browsing and grazing animals, insect and disease, vegetative competition, and rodents.

One major problem is the Southwestern ponderosa pine seed's temperature controlled dormancy. Seeds of this ponderosa do not germinate until the temperature averages above 55° F and the seeds are kept continually moist for at least 7 days. These conditions are not commonly met until July. Therefore, perhaps one major inhibitor in natural regeneration is the seasonal distribution of temperature and precipitation. The two cycle precipitation pattern, with wet winters and summers and dry springs and falls, limits germination to the period of summer rains in most years. Since germination requirements are not usually met until July, there is only a short growing season remaining until drought and frost begin. Coordination of a good seed supply, either natural or artificial, with adequate and timely precipitation the following summer is rare.

Because of the short growing season most seedlings cannot survive the fall drought, winter frost heaving, or transpiration stress. Generally only those seedlings that start early enough to develop an adequate root system can survive the first year.

Site preparation is one way to conserve soil moisture for seeds. In the past, chemical application has proven the most cost-effective as large areas can be covered quickly and efficiently, killing off weeds and grasses which will serve as mulch to conserve soil moisture. Today, however, due to environmental concerns, mechanical site preparation, although not as cost-effective, may become the best method, particularly on tracts of State and private lands which are much smaller than Federal tracts.

One method of mechanical site preparation is disking. An entire area can be prepared for artificial seeding, or in the case of natural seeding, areas can be disked around good cone producing trees. Other methods include chaining, in which a heavy chain is dragged between two dozers to disturb the soil and kill vegetative competition; brush clearing machinery, which cut down and chew up competing vegetation to provide mulch; and burning. Burning an area must be done with extreme caution and under exact conditions to insure against excess residual stand loss and adverse changes in chemical, physical, and microbial characteristics of the soil. To prevent moisture loss on mechanically prepared sites, the seeds must be covered.

Planting has proven to be the most effective method to date. A site can be prepared mechanically and planted by hand or machine. Planting is much more expensive than seeding, but has a much better chance of success.

TABLE 3-6

RURAL FIRE DEPARTMENTS
LITTLE COLORADO RIVER BASIN
ARIZONA

NAME OF DEPARTMENT	STATUS-CITY, DISTRICT, ASSOC.	AREA OF PROTECTION (SQ. MILE)	COOPERATIVE AGREEMENT W/ STATE	MANPOWER LEVEL	EQUIPMENT LEVEL	FUTURE PLANS	ADDITIONAL COMMENTS
Clear Creek Pines, Units 8 and 9	Association	1	Yes	4-6	1-Jeep w/50 gal. tank & pumper 1-M-37 w/200 gal. pumper & trailer	Add 200 gal. tank w/pumper	
Clear Creek Pines, Units 4, 5, and 6	Association		Yes		1-Dodge 4X4 crew cab w/200 gal. tank and pumper		Must acquire SCAT truck to meet protection plan
Concho	District	22	Yes	16	1-pumper w/250 gal. tank & 400' of 1½" hose 1-1,000 gal. tanker w/1,300' of 2½" hose Motorola communication pagers	Acquire SCAT truck and expand area of protection	
Doney Park	Association	126	Yes	24	1-C800 Ford Fire Engine w/750 gal. tank 2-2½T. 6X6 GMC tankers w/1,250 and 1,650 gal. 1-3/4T. truck w/pumper & 200 gal. tank 2-3/4T. M-37 4X4 Dodges w/pumper & 200 gal. tank 1-IHC engine w/500 gal. tank	1-3/4T. 4X4 M-37 w/pumper & 200 gal. tank 1-light plant 2-½T. 4X4 Jeeps additional manpower	
Flagstaff	City	64	Yes	48	3-structural engines 3-4X4 pumper units 1-tanker 3-command vehicles	3-additional employees 1-fire engine	
Forest Lakes	District	2	Yes	12	1-6X6 truck w/500 GPM pumper 1-6X6 w/675 GPM pumper & 2,000 gal. tank 1-4X4 equipment truck 1,000' of 2½" DJ hose; 500' of 1½" of SJ hose 2-SCBA's	1-4X4 quick attack truck 100 GPM pumper w/750 gal. tank additional hose 2-SCBA's	Have just completed addition. All surrounding land is Forest Service

TABLE 3-6 (Continued)

RURAL FIRE DEPARTMENTS
LITTLE COLORADO RIVER BASIN
ARIZONA

NAME OF DEPARTMENT	STATUS-CITY, DISTRICT, ASSOC.	AREA OF PROTECTION (SQ. MILE)	COOPERATIVE AGREEMENT W/ STATE	MANPOWER LEVEL	EQUIPMENT LEVEL	FUTURE PLANS	ADDITIONAL COMMENTS
Ganado	Association	400	Yes	40	2-pumper units 1-search & rescue	2-Fire engine attack company 1-ambulance; 1-1,000 gal. tanker truck; 1-1T. 4X4 250 gal. quick attack truck. Continued development of EMT/SR program	
Greer	Association	25	Yes	15	1-1948 IHC pumper 1-6X6 tanker 1-Jeep & trailer	1-pumper truck; 20 volunteers 1-1,200 gal. fold-a-tank Exchange Jeep & trailer w/state for larger truck; larger capacity portable pump.	Area protected will remain the same but as population grows equipment, training, & manpower will be upgraded.
Heber-Overgaard	District	102	No	14	1-1975 F880 Boardman w/1,000 gal. tank & 150 GPM midship pump & 750 GPM 1-1947 Studebaker w/350 gal. tank & 2 pumps 1-1975 Dodge rescue wagon	Additional manpower. Get rid of 1947 Studebaker and acquire a 4X4 SCAT truck.	
Holbrook	City	6	No	30	1-100 GPM pumper w/500 gal. tank 2-1,000 GPM pumpers w/750 gal. tanks 1-hose truck 1-equipment truck	1-1,500 GPM pumper w/800 tank on order	Are allowed to take 1 truck and 1 compact out of town
Pinetop	District	12	No	20	6-fully equipped fire trucks	In process of building a new addition to the fire house which will include a hose drying tower.	

TABLE 3-6 (continued)

RURAL FIRE DEPARTMENTS
LITTLE COLORADO RIVER BASIN
ARIZONA

NAME OF DEPARTMENT	STATUS-CITY, DISTRICT, ASSOC.	AREA OF PROTECTION (SQ. MILE)	COOPERATIVE AGREEMENT W/ STATE	MANPOWER LEVEL	EQUIPMENT LEVEL	FUTURE PLANS	ADDITIONAL COMMENTS
Puerco Valley	Association	1,200	Yes	10	2-trucks 1-1,500 gal. tank	Become a district and expand area of protection.	
Show Low	District	42	Yes	25	4-pumpers w/500-1,000 GPM pumps	Growing and expanding in all areas	
Springerville	City	2.54	No	20	2-750 Boardman pumpers fully equipped. 1 is set up to roll on wildland fires.	Additional manpower 1-1,200 or 1,500 GPM equipped pumper	Agreement with Apache County to respond in a 17 mile radius. Mutual aid agreement with Eagar.
Timberline-Fernwood	District	22	Yes	25	1-3/4T. truck w/pumper & 250 gal. tank 1-3/4T. truck w/1,000 gal. tanker	1-pumper; 1-1 or 2,000 gal. tanker 11 additional fire-fighters build a fire	A young developing Company. In a year a majority of men will be trained in basic firefighting.
Winslow	City	12	No	9-paid 12-volunteers	3-pumpers 1-mini-pumper 1-Jeep w/deck gun	Add a second station and additional equipment.	Will respond within a 30 mile radius of town.
Arizona State Land Dept. Div. of Forestry	Statewide			30	7-4X4 trucks w/pumpers & 150 gal. tanks 2-4X4 trucks w/pumpers & 125 gal. tanks 1-4X2 truck w/pumper & 100 gal. tank 50-man rolling cache; 9-5 man-caches; Supply truck w/fuel, water, & supplies; Misc. aircraft on "offer for hire"; Walkie-Talkies; portables, mobiles, and basic units.	Constant upgrading of equipment and training of personnel.	

Whether planting or seeding, grazing animals can destroy any chance for the establishment of adequate stocking levels if not fenced out of the area for 4 to 5 years. Rodents and insects are also a major obstacle in establishing regeneration. Chemically treated seeds, poison, and trapping eliminate some but not all of the pests. An effective means of protecting terminal leaders from browsing animals are plastic mesh tubes (photo 3-4). The tubes are placed over the seedlings and secured to the ground by pins, laths, or stakes. The tubes will eventually degrade from exposure to sunlight in anywhere from 3½ to 10 years depending upon the color and amount of ultraviolet inhibitor in the plastic.

Poor planting technique has contributed to low survival rates in the past and greater care must be taken when hand planting. Where practical, machine planting is best.



Photo 3-4: Plastic mesh tube for seedling protection

A good management plan should include site preparation for regeneration in the logging process. Logging activity and slash disposal could be combined to leave most cutover areas in good condition for regeneration. On State and private lands logging and timber stand improvement measures could be timed so that, when finished, the area would be most receptive to seeds. The movement of skidders dragging logs and the location of the logging decks sufficiently disturb the soil to ready it for seeding or planting. Care must be taken during the operation not to unduly harm any regeneration already present.

To date, the States have relied upon natural regeneration, but because of aforementioned obstacles, some sites have failed to regenerate naturally. Normally, a 5-year period should be sufficient for natural regeneration to occur, and a maximum of 10 years be allowed to establish an adequate stocking level. Because some sites have failed to regenerate naturally,

Arizona has incorporated an annual reforestation plan into its timber management plan. The annual reforestation plans will address the following:

- 1) Location of plantings
- 2) Priorities of plantings
- 3) Description of planting practices, standards, and specifications
- 4) Discuss provisions for training, supervision, and inspection of outplantings
- 5) Animal control prevention
- 6) Climatic conditions for outplanting
- 7) Species selection
- 8) Follow-up reports of costs and survival

To facilitate and aid the reforestation program, Arizona has constructed a cold storage facility in Flagstaff. With the unpredictable climatic variations during the early spring, late summer, and early fall (times to outplant to insure an adequate survival rate in northern Arizona), it is critical to have the flexibility to maintain tree seedling dormancy from early spring through August in the cold storage facility until the right temperatures and moisture conditions are sufficient to outplant. The facility will also enable the state to have seedlings available for immediate planting after any disasters.

According to a 1979 survey of private nonindustrial forest landowners in northern Arizona, only 1.3 percent of the respondents currently hold or in the future will hold their land for speculation on forest products. The primary reasons for currently owning forested lands are 1) vacation residence; 2) permanent residence; 3) recreation; and 4) speculation on real estate value. Future reasons fall into a similar ranking, but two new reasons become important - speculation on real estate value (ranked third) and commercial development (ranked fourth).

Management activities undertaken vary from none to highly intensive forest management such as precommercial thinning. Planting of trees was one of the more frequently performed activities in the past and ranks high as a planned future activity. Most of the respondents had not heard of cost-share programs, such as Forest Incentives Program (FIP) or the Agricultural Conservation Program (ACP) both of which reimburse a landowner up to 75 percent of the cost for specific management activities including planting. Of those that had not heard of these programs, over 56 percent expressed a willingness to participate in the future.

It appears that most forest landowners have objectives other than forest products. Management plans for these individuals must address other objectives. With sound forestry practices it can be shown that not only are their primary objectives met, but the timber resource is benefited, as well as enhancing the value of their property.

Upon completion of a silvicultural practice the owner could wait for 5 years, and after that time, if there is not sufficient regeneration, and if it meets the owner's goals, the area could be planted with seedlings.

The States currently administer the Tree Seedling Distribution Program (CM-4) for the benefit of private landowners with various species offered for sale to qualifying landowners for reforestation, windbreaks, and Christmas tree plantations. The purpose of the program is to encourage rural residents to establish tree stand for personal comfort, erosion control, noise abatement, wildlife cover, conservation of the timber resource, and in the case of Christmas tree plantations, additional income. The program has been a huge success and continues to grow in popularity. Last year 213,300 seedlings were sold. The program's goal is to distribute 500,000 seedlings per year by 1985.

OPPORTUNITIES FOR MANAGEMENT

Arizona's growing population and economy are generating ever-increasing demands for forest and woodland products (see Tables 3-7, 3-8, and 3-9). Estimated present and future employment in the forest industry is given in Table 3-10. Together with these demands are demands for more wilderness, recreational development, and wildlife areas. To meet these needs every acre currently under timber management must be more intensively managed to obtain continuous production at a level as high as is economically and ecologically possible.

Because most of the areas desirable for wilderness, recreation, and other uses are on Federal lands, future timber production and utilization in some areas may be severely curtailed or halted to meet other requirements. To compound the problem, a survey of private nonindustrial landowners showed that only 1.3 percent held their forest land for the purpose of timber production. To meet future needs the state will have to play an increasing role in forest and woodland products production and more intensively manage their available resources.

To more intensively manage and utilize the available resources several methods can be used. Computer simulation models can be developed to project stand data over a number of years or length of rotation. These projects can be used in the development of future management guidelines.

To obtain more wood from trees, programs such as the Improved Harvesting Program (IHP) and the Sawmill Improvement Program (SIP) have been undertaken in cooperation with the Forest Service. The Falling and Bucking Activity (FAB) portion of IHP consists of a computer analysis of wood fiber actually recovered from each tree, compared to the maximum cubic and board foot volume that could be recovered from the same tree by falling or bucking it differently. SIP concentrates on identifying problems in sawmills that result in lower lumber recovery.

Areas that have failed to regenerate naturally will have to be planted and areas that may not regenerate naturally will have to be identified so they can be planted after a harvest. Every precaution will have to be taken to ensure adequate survival and establishment of desired stocking levels. Activities to prevent or control insect and disease on forest and woodlands have been discussed on pages 3-15 through 3-19.

FUTURE DEMAND OF FUELWOOD BUSINESS ^{1/}

ARIZONA

POPULATION CENTER	YEARS										TOTAL
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	
----- CORDS -----											
PHOENIX											
Commerical & Personal Paid	2,800	3,300	3,800	4,250	4,750	5,200	5,700	6,150	6,700	7,150	49,800
Free Use	6,000	6,900	7,800	8,700	9,700	10,700	11,600	12,500	13,600	14,700	102,200
Total	8,800	10,200	11,600	12,950	14,450	15,900	17,300	18,650	20,300	21,850	152,000
TUCSON											
Commercial & Personal Paid	8,800	10,125	11,725	13,125	14,775	16,125	17,725	19,000	20,500	22,000	153,900
Free Use	2,600	3,000	3,125	3,600	4,000	4,400	4,800	5,100	5,500	5,900	42,025
Total	11,400	13,125	14,850	16,725	18,775	20,525	22,525	24,100	26,000	27,900	195,925
FLAGSTAFF											
Commercial & Personal Paid	2,500	2,750	3,000	3,250	3,500	3,750	4,000	4,250	4,500	4,750	36,250
Free Use	18,000	20,000	21,500	23,000	25,000	26,500	28,000	30,000	31,500	33,000	256,500
Total	20,500	22,750	24,500	26,250	28,500	30,250	32,000	34,250	36,000	37,750	292,750

^{1/} Supply, Demand, and Economics of Fuelwood Markets in Selected Populations Centers of Arizona. 1979.
 Arizona Landmarks, Volume 9, Book 2, Arizona State Land Department.

T A B L E 3-7 (Continued)

FUTURE DEMAND OF FUELWOOD BUSINESS ^{1/}

ARIZONA

POPULATION CENTER	YEARS										TOTAL
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	
----- CORDS -----											
PRESCOTT											
Commercial & Personal Paid	3,500	3,750	4,000	4,225	4,500	4,750	5,000	5,225	5,500	5,750	46,200
Free Use	16,500	19,000	22,000	24,500	27,250	30,000	32,500	35,000	37,000	45,000	288,750
Total	20,000	22,750	26,000	28,725	31,750	34,750	37,500	40,225	42,500	50,750	334,950
SHOW LOW											
Commercial & Personal Paid	14,500	18,500	22,500	26,500	31,000	35,000	39,000	43,500	47,500	51,500	329,500
Free Use	30,500	35,500	40,250	45,000	50,000	55,000	60,000	65,000	70,000	75,000	526,250
Total	45,000	54,000	62,750	71,500	81,000	90,000	99,000	108,500	117,500	126,500	855,750
ARIZONA (TOTAL)											
Commercial & Personal Paid	32,100	38,425	45,025	51,350	58,525	64,825	71,425	78,125	84,700	91,150	615,650
Free Use	73,600	84,400	94,675	104,800	115,950	126,600	136,900	147,600	157,600	173,600	1,215,725
Total	105,700	122,825	139,700	156,150	174,475	191,425	208,325	225,725	242,300	264,750	1,831,375

T A B L E 3-8

Little Colorado River Basin
Projected Volume and Area of Growing Stock on
Commercial Timberlands by Stand Classes
(Million Cu. Ft. and 1,000 Acres)*

: Year	: Sawtimber	: Pole- timber	: Total Volume	:	: Sawtimber	: Pole- Timber	: Seedling- Sapling	: Non- Stocked	: Total Area
: 1980	: 1,680	: 220	: 1,900	::	: 1,266	: 70	: 30	: 30	: 1,396
: 2000	: 1,430	: 420	: 1,850	::	: 1,188	: 90	: 45	: 10	: 1,333
: 2020	: 750	: 1,050	: 1,800	::	: 1,117	: 100	: 60	: 7	: 1,284

* Reference: Lower Colorado Region, Comprehensive Framework Study, 1970.

T A B L E 3-9

Little Colorado River Basin
Projected Timber Products Harvested and
Net Annual Growth on Commercial Timberlands (Million Cu. Ft.)*

: Year	: Sawlogs ^{1/} Harvested	: Pulpwood Harvested	: Other Wood Products Harvested	:	: Total Timber Harvested	: Net Annual Growth
: 1980	: 20	: 19	: 1	::	: 40	: 50
: 2000	: 41	: 30	: 2	::	: 73	: 60
: 2020	: 29	: 38	: 3	::	: 70	: 75

^{1/} Includes harvested for veneer and particle board.

* Reference: Lower Colorado Region, Comprehensive Framework Study, 1970.

T A B L E 3-10

LITTLE COLORADO RIVER BASIN
PRESENT AND PROJECTED EMPLOYMENT
IN TIMBER-BASED INDUSTRIES ^{1/}
(Man-Years)*

Year	Timber Management	Timber Harvest	Sawmills and Planer Mills	Veneer & Plywood Plants	Particle Board Plants	Pulp, Paper, & Allied Products	Other Timber Products	Total Man-Years
1965	410	325	1,515	0	0	1,465	335	4,050
1980	525	395	865	585	125	1,420	635	4,550
2000	750	425	515	405	350	1,320	735	4,500
2020	1,000	415	340	400	350	1,180	775	4,460

^{1/} Includes total employment (public and private) timber-based industries on commercial timberlands.

* Reference: Lower Colorado Region, Comprehensive Framework Study, 1970.

Even under intensive management, State lands will not be able to meet future demands for forest and woodland products. The private sector must play a larger part in the future. Education of the private landowner in sound forestry practices must be more widespread, showing that main objectives can be met while also benefiting the timber resource.

To encourage private landowners to manage their forests and woodlands there are cost-share programs such as the Forest Incentives Program (FIP) and the Agricultural Conservation Program (ACP) and free technical assistance through the State Land Departments, Divisions of Forestry, the Agricultural Stabilization and Conservation Service (ASCS), the Soil Conservation Service (SCS), and the United States Forest Service (USFS).

A growing concern in Arizona is that community expansion and rural subdivisions are resulting in some of the best timber growing lands being taken out of production. Also lost is valuable wildlife habitat. State and local officials with responsibilities for enacting and administering laws and ordinances pertaining to land development, must be aware of these potential losses.

Protection of riparian vegetation within the forest and woodlands is critical to maintain and improve wildlife habitat.

Technical assistance in identifying prime forest land, key riparian vegetation and critical wildlife habitat is available from the Soil Conservation Service, Forest Service, Fish and Wildlife Service, State Forestry Divisions, and State Fish and Game Departments.

Cattle grazing is an intricate part of the management of the ponderosa pine and juniper-pinyon ecosystems. Grazing is also an important segment of the Basin's economy. Therefore, the forest and woodlands must be managed to optimize total resource production based on the capability of the land. Silvicultural practices should provide for increased forage production and improved wildlife habitat along with increased timber yield.

The Southwestern Region of the USDA Forest Service has developed a system for classification, mapping, and interpretation of terrestrial ecosystems. By recognizing and measuring cause/effect relationships in the terrestrial ecosystems, production coefficients have been developed for 26 regional terrestrial ecosystems.

Resource production is a function of biological and physical attributes of the land, including climate, soils, and vegetation. Climate and soils are used to delineate capability areas and therefore are considered fixed with relationship to man's manipulation. The vegetative component is not fixed and can be readily altered through management. Because of this relationship, it is necessary to tie production within an ecosystem to vegetative characteristics and physical characteristics that are subject to change as a result of man's interactions.

Historically, production estimates have been made for forage, timber, water, etc., independently from one another or with little coordination. The Forest Service is using the relationships within ecosystems to interrelate multiple resource production potentials in their Land Management Planning. As an example, within the ponderosa pine ecosystem, the number of trees per acre and average diameter can be used as integrating characteristics to describe resource production. Within this ecosystem, given that the soil is uniform, average basal area is used as one vegetative characteristic to describe or link timber production, water yield, and forage production. Thus, once the planner or land manager agrees on the timber basal area levels, the production coefficients of other resources are available. The process allows the decision maker to evaluate a larger spectrum of management alternatives and opportunities.

SUPPLEMENTARY DATA

NAVAJO FOREST INFORMATION

The following information on the Navajo Forest was prepared by the Bureau of Indian Affairs, Navajo Area Office Foresters for use in the Little Colorado River Basin Study. This will provide the reader with an insight as to the kind and amount of timber on the Navajo Reservation. It also describes the management guides and silviculture prescriptions used.

Compartment Examination

Compartment examination began on the Navajo Forest in 1977. The purpose was to subdivide the forest into units so that it could be managed more effectively. The advantages are to help determine which stands need silvicultural treatment, their location, size, and type of treatment needed. Also to estimate timber volumes, forest acreage, and stand composition.

The Navajo Forest is divided into 62 compartments, and each year six or seven compartments are inventoried. After 10 years, the entire forest will have been surveyed. This will be accomplished by 1986. Compartment size is determined by permanent boundaries made up of roads, drainages, cliffs, and other natural features. The compartment is then further subdivided into forest stands which range from 5 to 50 acres depending upon compartment size and uniformity. The stands are delineated by species, age, density, regeneration, condition, and topographic features. The stands are temporary and change over years as the forest changes due to growth, logging, insect damage, forest fire, etc.

In addition to the compartment exam currently underway, in 1977 Natural Resource Management Corporation was contracted to provide a timber type map for the forest. This mapping was done using the latest aerial photography and then reproduced on U.S.G.S. Quad maps at a scale of 1:24,000.

Management Guides

Presently the forest development section has been actively engaged (3 years) in a compartment examination procedure which follows the USFS Region 3 Compartment Handbook very closely. Within the Little Colorado River Basin we have 27 compartments for a total of 227,901 acres of commercial forest land.

Basically, our forest within the Basin falls into six silviculture prescriptions. Before discussing acreage determination for each prescription, let's define our definition for the prescriptions.

No Cut: is prescribed for stands where either 1) there is inadequate volume for economical logging operations, 2) there are environmental factors prohibiting logging operations, or 3) stocking density has been reduced to minimum or below minimum levels and there is a need for regeneration but the stand is lacking in reproduction.

Final Removal Cut: prescribed in two- or multistoried stands with an adequately stocked (GSL 60 or above) understory component of sapling size or larger. It calls for a complete removal or harvest of the mature overstory component to release the understory replacement stand.

Partial Removal Cut: is also prescribed in two- or multistoried stands with an adequately stocked understory component. In contrast to the final removal cut, however, the stand understory component needs the protection of shelterwood. Stands in exposed locations and/or with an understory component of seedlings or saplings frequently receive this prescription. It calls for removing all but 20 to 30 basal feet of the mature overstory component.

Group Selection: is prescribed when a stand is too variable in age, stocking density, and/or timber type to be treated uniformly. In these cases, individual groups of mature trees are harvested to release understory components, provide openings for regeneration, and/or harvest overmature sawtimber before its loss to mortality.

Intermediate Cut: is prescribed to open up space in young, overstocked sawtimber stands. It is often prescribed in conjunction with a removal cut if the manageable component of the stand is in need of thinning and of merchantable size. The prescription calls for cutting all but 60 basal feet of the young sawtimber stand component.

Salvage Cut: is prescribed in mature and overmature sawtimber stands with regeneration problems that are suffering mortality from decadence and disease yet have sufficient volume and stocking levels to justify harvesting. When prescribed, only the highest risk trees in the stand (those that would not survive until the next stand entry; about 20 years) are harvested.

There are, of course, other prescriptions which may be made for stands in the Little Colorado River Basin during the process of compartment examination. These include preparatory cuts, seed cuts, and individual tree selection cuts. However, stands and the corresponding acreages requiring these treatments are impossible to identify from available forest stand type data. An explanation of the stand types included in the acreage base for the various prescriptions follows. Those stands receiving a no cut prescription are either, 1) fringe, 2) immature and not of harvestable size or, 3) single storied, mature lacking reproduction and understocked. Partial or final removal prescriptions have been made for overstocked, multistoried stands and two-storied stands with an adequately stocked, youthful, understory component. Multistoried, ponderosa pine stands with highly variable densities (adequate to overstocked), have been earmarked for group selection prescriptions. Intermediate cuts have been prescribed for overstocked, large pole-timber and immature sawtimber stands. For mature and overmature, single storied sawtimber stands at lower levels of acceptable stocking, salvage cuts have been prescribed.

Thinning: Precommercial thinning before 1977 was primarily conducted by the Navajo Tribe's Branch of Forestry. Cost of the program is very high (approximately \$140 per acre for thinning and chipping) as compared to outside contractors. The tribal organization averaged around 1,700 acres per year since the program began in 1970.

Since 1977, the Tribe's Forestry program has concentrated on management objectives rather than TSI type projects, thus, there has been no thinning from the tribal organization.

But, in 1977, the BIA began a large-scale precommercial thinning program with additional money allocated by Congress to alleviate backlogs in this TSI area, acreage accomplished within study area are:

FY 1977 - 1,244 acres
FY 1978 - 2,984 acres
FY 1979 - 2,133 acres

Specifications on the majority of the thinning are 6 inches or 8 inches upper diameter limit with either 10'x10' or 12'x12' spacing. GSL (Growing Stock Levels) are 60 or 80.

VOLUME OF PONDEROSA PINE ON THE NAVAJO FOREST

Introduction

The Navajo Reservation Forest encompasses approximately 439,402 acres (Table 3-16), and lies within the States of Arizona and New Mexico. The elevational range of this forest is from 6,800 feet to 9,300 feet. Annual precipitation varies within the two distinct geographical areas, the Defiance Plateau and Chuska Mountains. The Defiance Plateau lies at a lower elevation than the Chuska Mountains. Within these two geographical areas, the forest is composed of different species. Mixed conifer is more prevalent on the Chuska Mountains than on the Defiance Plateau. The species ponderosa pine (Pinus ponderosa, Laws) composes nearly all the acreage of the Defiance Plateau, with some Douglas-fir (Pseudotsuga menziesii, Mirb.) growing on the north aspect of side canyons and deep drainages. Also, aspen (Populus tremuloides, Michx.) is present along these same topographical features, but in miniscule amounts. The higher elevational range of the Chuska Mountains with its higher amount of precipitation, supports more varied species. Douglas-fir, corkbark fir (Abies lasiocarpa var. arizonica, Merriam, Lennon), blue spruce (Picea pungens Engelm.), aspen, and ponderosa pine occupy sites located on this mountain range.

Purpose

A general overall view of the Navajo Forest is presented here to give an individual not familiar with the area an idea of where the forest is and what it is composed of.

The estimation of timber volume on the Navajo Forest is subject to the estimators biases and methods of calculations. Previous studies have been conducted on the potential forest timber yields and conditions, with different conclusions.

Methods

The Navajo Nation Forest Management Branch initiated an inventory in the summer of 1978 over the total commercial forest land. Inventory design utilized was selection of forest stands located on or close proximation to 5,000 meter grid interval points on a U.S.G.S. map of 1:250,000 scale. The map points are actually UTM (Universal Transverse Mercators) grid points. With these points selected, the sampling process was divided into primary and secondary sampling of timber stands. The inventory data collected, compiled, and analyzed are all from the primary sampling points. Secondary sampling, with revision for selection of stands to be sampled is now in progress.

The statistical analysis for the inventoried stands were based on the timber types as identified by timber symbols on the timber type map. After conducting statistical tests on these timber types, site index as a variable of stratification proved to be inconclusive. Therefore, using site index classes as a means of stratification of timber types was not

implemented in calculation of the different type volumes. An average site index was calculated forest wide, and used for site index value on the computer program PIP0.

Results

The volume per acre estimated on the Navajo Forest was 6,693 board feet (bf.). Previous studies aforementioned included Dr. Minor's study in 1977 which estimated 6,000 Bf/acre ^{1/}. The inference figure of 6,693 Bf/acre resulted from the sampling of the primary inventory points. In the ponderosa pine type there were 61 stands that were sampled. The timber types sampled are shown by Table 3-11. The volume per acre figure is based on average basal area of each timber type. The use of average figures may have resulted in the higher volume estimate. Total net board foot volume is given only for the State of Arizona and acreage in New Mexico is excluded. The volume calculations shown is within the range of previous estimates and is a general estimate, restricted to application in broad-based studies such as the Little Colorado River Basin Study. The use of these volume estimates should not be used for more intensive management purposes such as timber management plans. As more accurate timber stand data becomes available, the better accuracy the estimation of the timber volume will be.

^{1/} Minor, Charles O. D. F., "Mismanagement of the Forest Resources of the Navajo Reservation," June 1977.

TABLE 3-11

PONDEROSA PINE VOLUME ESTIMATES
By PIPO SIMULATION MODEL

NAVAJO FOREST

Site Index 80

Total Type Acreage	Over- story Avg. D.B.H. (Inches)	Over- story Avg. B.A. (sq. ft.)	Under- story Avg. D.B.H. (Inches)	Under- story Avg. B.A. (sq. ft.)	Cu. ft. Vol/Acre	Bd. ft. Vol/Acre	Total Cu. ft. Vol.	Total Bd. ft. Vol.
371	6.35	49.36	-0-	-0-	461	-0-	171,031	-0-
91	6.35	40.71	-0-	-0-	380	-0-	34,580	-0-
1,478	21.74	83.33	-0-	-0-	2,685	15,069	3,968,430	22,271,982
14,712	21.74	49.36	-0-	-0-	1,591	8,930	23,406,792	131,378,160
80	21.74	40.71	-0-	-0-	1,309	7,349	104,720	587,920
29,319	22.74	49.36	-0-	-0-	1,459	8,186	42,776,421	240,005,334
34,143	22.74	40.71	-0-	-0-	1,202	6,744	41,039,886	230,260,392
418	22.74	22.00	-0-	-0-	646	3,628	270,028	1,516,504
2,703	19.89	24.68	8.72	24.68	651	2,713	1,759,653	6,333,239
593	19.89	20.35	8.72	20.35	537	2,237	318,441	1,326,541
2,578	22.74	22.00	1.625	40.71	646	3,628	1,665,388	9,352,984
15,580	22.74	22.00	6.35	40.71	1,027	3,628	16,000,660	56,524,240
4,465	22.74	22.00	6.35	49.36	1,107	3,628	4,942,755	16,199,020
140	21.74	22.00	1.625	40.71	713	4,000	99,820	560,000
1,566	21.74	22.00	1.625	49.36	713	4,000	1,116,558	6,264,000
92	22.74	22.00	21.74	40.71	2,785	15,627	256,220	1,437,684
108,329							137,931,383	724,018,000

GROWTH OF PONDEROSA PINE ON THE DEFIANCE PLATEAU OF THE NAVAJO FOREST

Introduction

Measurement of growth, both actual and potential, in timber on the Navajo Forest is complicated by the poor quality and lack of data. Although CFI plots were established by 1969 and remeasurements were made for the Defiance Plateau, forest-wide information is not presently available. Projections ^{1/} were made for the Chuska/Tsaile units, however, the results were so low (6.06 cubic feet per acre per year) the methods of sample design, measurement, and/or calculation ^{2/} must be questioned. Measurement of site index from timber type maps ^{3/} must also be seriously questioned as Analysis of Variance has shown the map classes to be significant at an extremely low level.

Purpose

The purpose of this brief paper is to provide, based on the best information available, growth data for the Arizona portion of the Navajo Commercial Forest area. The data will be used for the Little Colorado River Basin Study.

Methods

Data was drawn primarily from one source, CFI plots on the Defiance Plateau. This data was best summarized in a recent report which analyzed 75 CFI plots and used multiple regression techniques to study the relationship between cubic feet volume growth with stocking level chemical and physical soil characteristics, and physical site characteristics ^{3/}.

Results

The average cubic feet volume growth per acre per year on the Defiance Plateau (encompassing a large majority of the Navajo Commercial Forest within Arizona) is estimated at 16 cubic feet gross growth. The single factor most important to this rather low growth estimate was the stocking rate, that is, basal area. The growth study, as shown in several other studies, indicates the basal area stocking rates to be alarmingly low ($X=43$ ft./acre, Table 3-13). Where basal areas were higher, so were growth estimates. In fact, on the 75 plots analyzed, 58 percent of the difference in growth can be linked to stocking levels. The number of plots by 10 cubic feet growth intervals is provided in Table 3-12.

^{1/} Kendley, John B., 1976, Memorandum to the BIA Area Forester, re: Summary of 1975 Chuska Unit Growth Remeasurement Reports.

^{2/} Natural Resources Management Corp., Eureka, California, 1977.

^{3/} Henry, Gerald L., 1979, What Makes Ponderosa Pine Trees Grow Better on Some Parts of the Defiance Plateau, Navajo Forest Management Branch, Fort Defiance, Arizona 86504.

TABLE 3-12.

DISTRIBUTION OF CUBIC FEET GROWTH PER ACRE PER YEAR
ON 75 CFI PLOTS WITHIN THE DEFIANCE PLATEAU

<u>CUBIC FEET GROWTH</u>	<u>NUMBER OF PLOTS</u>
0-10	16
11-20	37
21-30	15
31-40	4
41-50	3
51 +	0

TABLE 3-13.

A STATISTICAL SUMMARY OF PRELIMINARY FOREST INVENTORY RESULTS IN
PONDEROSA PINE STANDS ON THE NAVAJO FOREST (ARIZONA AND NEW MEXICO)

<u>VARIABLE</u>	<u>MINIMUM VALUE</u>	<u>AVERAGE</u>	<u>MAXIMUM VALUE</u>
Overstory Age	103	188	310
Understory Age	0	66	116
Overstory Basal Area	3	21.9	48
Understory Basal Area	0	20.3	68
Total Basal Area	5	43.7	116
Percent Stocking with Seedlings	0	.33	153
Site Index	47	79.82	125

VOLUME OF PONDEROSA PINE-DOUGLAS-FIR STANDS ON THE NAVAJO FOREST

Introduction

Within the Arizona portion of the Navajo commercial forest, there are 3,816 acres classified as ponderosa pine-Douglas-fir (Pf) ^{1/}. These stands grow predominately on north aspects of side canyons and deep drainages within and along the breaks of the Defiance Plateau and Chuska Mountains.

Purpose

The purpose of this paper is to provide a general overview of Pf stands within the Navajo Forest. The estimations of timber volume are subject to estimators biases, small sample size, and methods of calculation. The paper was written specifically for the Little Colorado River Basin Study and for the purposes intended, it should serve well. The data is not intended to be used on study areas of smaller size, nor should it be used for calculation of expected return or timber management.

Methods

The empirical data were collected during the primary or estimator cruise ^{2/}. The primary sample transects were located using systematic sampling techniques based on a 5,000 meter grid. The empirical data were stratified by timber type map classes and subjected to statistical analysis (Table 3-14). Average diameters were determined for each stand structure class and average basal areas were determined for crown density class. The number of trees per acre was determined by dividing the total basal area (sq. ft./acre) by the basal area of an average diameter tree for the class ^{3/}.

Volumes, in cubic feet and board feet (Scribner Decimal C), were calculated by using the number of trees per acre as derived above and local volume tables for Douglas-fir. Use of Douglas-fir volume tables only for calculation of volume in mixed stands could result in an underestimation of volume.

Results

The results of the calculations are provided in Table 3-15, Mixed Pine-fir (Pf) Volume Estimates. The total acreage of Pf stands within the study area is 3,816 (Table 3-17). These stands contain a total of 4,891,028 cubic feet or 17,941,831 board feet (Scribner Decimal C) in timber. These figures translate to an average of 1,281.72 cubic feet or 4,701.73 board feet per acre.

^{1/} Natural Resources Management Corp., Eureka, California, 1977, Composite Type Map.

^{2/} Henry, Gerald L., 1978, Procedures Handbook for Inventory of Renewable Natural Resources on Navajo Lands, Draft 1, Navajo Forest Management Branch, Fort Defiance, Arizona 86504.

^{3/} Avery, Eugene T., 1967, Forest Measurements, McGraw-Hill Book Company, New York.

TABLE 3-14.

A STATISTICAL SUMMARY OF PRELIMINARY FOREST INVENTORY

RESULTS IN PINE-FIR (PF) STANDS ON

THE NAVAJO FOREST (ARIZONA AND NEW MEXICO)

<u>VARIABLE</u>	<u>MINIMUM VALUE</u>	<u>AVERAGE</u>	<u>MAXIMUM VALUE</u>
Overstory Age	108	166	214
Understory Age	34	67	109
Overstory Basal Area	7	23.8	49
Understory Basal Area	8	28.0	55
Total Basal Area	25	57.7	83
Percent Stocking with Seedlings	3	31	78
Site Index	71	91	109

TABLE 3-15

MIXED PINE-FIR (Pf) VOLUME ESTIMATES

NAVAJO FOREST

TOTAL TYPE ACREAGE	AVERAGE OVERSTORY DBH	AVERAGE OVERSTORY BASAL AREA	AVERAGE UNDERSTORY DBH	AVERAGE UNDERSTORY BASAL AREA	CU. FT. VOLUME PER ACRE	BU. FT. VOLUME PER ACRE	TOTAL CU. FT. VOLUME	TOTAL CU. FT. VOLUME
20	21.74	61	-0-	-0-	1,672	8,788	33,480	175,760
718	18.52	56	-0-	-0-	1,257	6,300	902,526	4,523,400
598	18.52	61	-0-	-0-	1,369	6,863	818,662	4,104,074
368	17.74	26	7.51	26	1,110	3,196	408,480	1,176,128
1,985	17.74	31	7.51	30	1,304	3,809	2,588,440	7,560,865
17	17.74	11	7.51	11	470	1,352	7,990	22,984
110	17.74	28	7.51	28	1,195	3,442	131,450	378,620

SUMMARY

The results of this study should be accurate enough for regional studies. Use for more detailed work should be avoided until the results can be supported by additional empirical data, (Tables 3-16 and 3-17).

TABLE 3-16.

TOTAL NAVAJO FOREST LANDS (Includes lands outside LCR Basin)

<u>Land Ownership</u>	<u>Commercial</u>		<u>Non-Commercial (Includes J-P)</u>	
	<u>Acres</u>	<u>Volume</u>	<u>Acres</u>	<u>Volume</u>
Private (Allotments)	9,100	(M ft. MB) 30,470	115,195	(M ft. BM) 192,570
Indian (Tribal)	430,302	1,381,548	3,485,787	4,253,178
TOTAL	439,402	1,412,018	3,600,982	4,445,748

TABLE 3-17.

NAVAJO FOREST LAND WITHIN LITTLE COLORADO RIVER BASIN

<u>Tree Species</u>	<u>Acres</u>	<u>Sawtimber MBF</u>	<u>Roundwood</u> (Cords)
Ponderosa Pine	224,085	1,399,727	
Pine-Fir	3,816	19,942	
Juniper-Pinyon	2,285,576		11,427,835

TABLE 3-18.

ZUNI RESERVATION FOREST INFORMATION
(all within Little Colorado RB)

<u>Commercial</u>		<u>Non-Commercial</u>	
<u>Acres</u>	<u>Volume MBF</u>	<u>Acres</u>	<u>Volume MBF</u>
15,000	29,986	1,550	Unknown
Woodland (Juniper-Pinyon)			
10-40% crown density		=	168,340 acres
40-70% crown density		=	<u>47,150 acres</u>
			215,490 acres

Source: Bureau of Indian Affairs, Albuquerque Area Office

NATIONAL FOREST SYSTEM INFORMATION

The Little Colorado River Basin includes portions of the Apache-Sitgreaves, Cibola, Coconino, Gila, and Kaibab National Forests. Each National Forest has a Timber Management Plan which describes the acres and volumes of timber, the allowable annual harvest, schedule of timber sales, and other information.

Commencing in 1980, each of these National Forests began to prepare a Land Management Plan containing information on the capability of the lands to produce timber and other resources (see Table 3-19 for completion dates of individual plans for each forest). When completed in 1983, the National Forest Land Management Plans will replace the current timber plans and other resource management plans.

Readers interested in National Forest timber information can review the above-mentioned plans at the National Forest Supervisor's Office. The data is presented by State, County, and Forest Service administrative boundaries. The data is not available by watershed or river basin hydrologic units.

TABLE 3-19.

DATES OF COMPLETION FOR SOUTHWESTERN REGION NATIONAL FORESTS
LAND MANAGEMENT PLANS (updated 5/81)

Planning	:	Apache-	:		:		:		:
Process Steps	:	Sitgreaves	:	Coconino	:	Gila	:	Cibola	:
	:		:		:		:		:
Plan of Work	:		:		:		:		:
Notice of Intent	:	Completed	:	Completed	:	Completed	:	Completed	:
	:		:		:		:		:
Public Involvement	:		:		:		:		:
on Issues & Manage-	:		:		:		:		:
ment Concerns Analy-	:		:		:		:		:
sis of Comments	:	5/81	:	5/81	:	9/80	:	2/81	:
	:		:		:		:		:
Data Collection	:		:		:		:		:
Analysis of Manage-	:		:		:		:		:
ment Situation	:	12/81	:	10/81	:	12/81	:	12/81	:
	:		:		:		:		:
Formulate Alterna-	:		:		:		:		:
tives	:	1/82	:	4/82	:	2/82	:	3/82	:
	:		:		:		:		:
Prepare File DEIS	:	3/83	:	10/82	:	10/82	:	3/83	:
	:		:		:		:		:
Comment on DEIS	:		:		:		:		:
File FEIS	:	9/83	:	6/83	:	3/83	:	9/83	:
	:		:		:		:		:
Implement and Monitor:	:	9/84	:	6/84	:	3/84	:	9/84	:
	:		:		:		:		:

GLOSSARY

Annual growth or annual increment: the layer of material added to a tree each year, consisting normally of one growth ring or annual ring.

Breast-height: a point on the stem of the tree 4.5 feet above the ground level as determined from the uphill side of the tree.

Codominant: trees with crowns forming the general level of crown cover and receiving full light from above but comparatively little from the sides; usually with medium-sized crowns more or less crowded on the sides.

Cull trees: live trees that do not contain at least 50 percent merchantable volume due to defect, rot, etc.

DBH: diameter measured at breast height. All diameter measurements except pinyon and juniper are taken at breast height unless an anomaly of the stem occurs at the height. In the case of pinyon and juniper, diameters are measured at stump height.

Defect: any irregularity in or on wood that may affect or limit its suitability for a particular end use.

Dominant: trees with crowns extending above the general level of crown cover and receiving full light from above and partly from the sides; larger than the average trees in the stand, and with crowns well developed.

Firebreaks: are trails freed of combustible material to stop the spread of fire onto the area protected. Firebreaks must be at least 8 to 12 feet wide, with at least a 2 to 4 foot wide continuous strip of mineral soil exposed and trees adjacent to firebreaks pruned to a height of 10 feet above ground.

Fire suppression lanes: are firebreaks which allow for passage of fire suppression vehicles. Whenever topography allows, firebreaks should be planned to serve as fire suppression lanes.

Forest type: a classification of forest land based on the predominant tree species, the type name being that of the species.

Fuelbreaks: are strips of land on which the vegetation has been thinned to provide a safe location for fire fighters to control a fire. Fuelbreaks reduce the fuel hazard and maintain the aesthetics of the area.

Fuel hazard: a measure of the amount of combustible material contributing to the fire danger in an area.

Fuelwood: wood - round, cleft, or sawn and generally otherwise refuse material - cut into short lengths for burning.

Grain (wood): the arrangement and alignment of fibers in wood.

Heartwood: inner portion of a woody stem, extending from pith to sapwood, usually darker in color and with lower moisture content than sapwood.

Intermediate cutting: any removal of trees from a stand between the time of its formation and the harvest cutting.

Inventory (timber): the measurement of volume, species composition, stand structure and stocking, growth, quality, and other characteristics descriptive of the timber resource.

Leader: the growing tip of the main stem of a tree.

Naval stores: refers to products of the resin industry, such as turpentine, resin, pine tars, and pitch.

Juniper-pinyon pine

Commercial forest land: land area occupied by at least 25 percent crown cover.

Noncommercial forest land: land area occupying less than 25 percent crown cover. Includes land dedicated to nonforest uses such as permanent roads or pipeline or power line right-of-ways, strips of trees less than 120 feet in width or less than an acre in extent, and rock, water, or other nonforest conditions.

Ponderosa pine - mixed-conifer

Commercial forest land: land areas occupied by at least 10 percent crown cover and capable of producing over 20 cu. ft./acre/year of wood fiber.

Noncommercial forest land: land area incapable of producing 20 cu. ft./acre/year of wood fiber. Includes land dedicated to nonforest uses such as permanent roads or pipeline or power line right-of-ways, strips of timber less than 120 feet in width or less than an acre in extent, and rock, water, or other nonforest conditions.

Precommercial: live trees having a DBH between 1.0 and 5.5 inches, inclusive.

Pulpwood: live trees of a commercial species having a DBH between 5.6 and 11.5 inches, inclusive.

Regeneration: established seedlings at least 6 inches in height and not greater than 5.6 inches DBH.

Salvage cutting: the removal of trees that are dead, dying, or deteriorating before their timber becomes worthless. These trees are usually overmature or materially damaged by fire, wind, insects, fungi, or other injurious agencies.

Sanitation cutting: the removal of dead, damaged, or susceptible trees, essentially to prevent the spread of pests or disease throughout the remainder of the stand.

Sapwood: outer portion of a woody stem, extending from the bark to the heartwood, usually lighter in color and with a higher moisture content than heartwood.

Sawtimber: live trees of a commercial species having a DBH equal to or greater than 11.6 inches and containing at least 8-foot sawlog with a minimum top DIB of 6.0 inches.

Seasoning: removing the water from wood by exposing to air for a period of time, or by controlled heating in a kiln.

Site trees: trees that are indications of the growth that can be achieved on a given site under ideal conditions.

Snag: dead but standing tree.

Stumpage: a term commonly applied to the valuation or price paid per unit volume for standing timber.

Stump-height: a point on the stem of the tree 12 inches above ground level as determined from the uphill side of the tree.

Thinning: the removal of unneeded, damaged, or diseased trees from crowded precommercial stands in order to provide adequate growing space for stand development and to upgrade the remaining stock.

Timber stand improvement (TSI): a loose term comprising all intermediate cuttings made to improve the composition, constitution, condition, and increment of a timber stand.

Wood pulp: pulp manufactured by either chemical or mechanical means from wood.

- a) Mechanical wood pulp - pulp produced by mechanically grinding or reducing the wood to fibers.
- b) Chemical wood pulp - pulp produced by chemically digesting the wood, removing most of the lignin and leaving principally cellulose fiber.

COMMON AND BOTANICAL NAMES OF SOME TREES
IN THE LITTLE COLORADO RIVER BASIN

Aspen, quaking	(<u>Populus tremuloides</u> Michx.)
Douglas-fir	(<u>Pseudotsuga menziesii</u> var. <u>glauca</u>)
Fir, corkbark	(<u>Abies lasiocarpa</u> var. <u>arizonica</u> Merriam)
Fir, subalpine	(<u>Abies lasiocarpa</u> var. <u>lasiocarpa</u> Hook.)
Juniper, alligator	(<u>Juniperus deppeana</u> Steud.)
Juniper, one seed	(<u>Juniperus monosperma</u> Engelmann, Sargent)
Juniper, Utah	(<u>Juniperus osteosperma</u> Torr. Little)
Oak, Gambel	(<u>Quercus gambelii</u> Nutt.)
Pine, ponderosa	(<u>Pinus ponderosa</u> Laws.)
Pinyon, common	(<u>Pinus edulis</u> Engelmann)
Spruce, blue	(<u>Picea pungens</u> Engelmann)
Spruce, Engelmann	(<u>Picea engelmannii</u> Parry)

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